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LORE TECHNICAL BULLETIN

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FOCUS ON LETE

LABOR OMNIA VINCIT

Canada

LORE TECHNICAL BULLETIN

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Send correspondence to:

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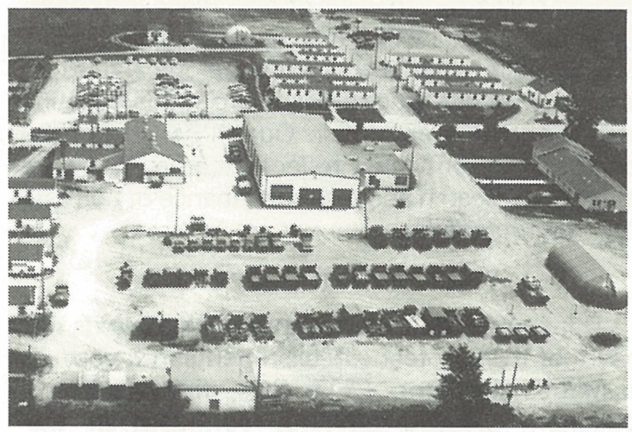
COVER

Our cover features an architect's model of the new main building planned for the present site of the Land Engineering Test Establishment located at Orleans, Ont., 12 km east of Ottawa. Construction is forecast to begin during the summer, 1984.

Also shown is the official LETE crest which was approved in 1981.

IN THIS ISSUE



A WORD FROM THE COMMANDING OFFICER

by LCol DB Perrin

The technology explosion is brought into sharp focus in the Land Engineering Test Establishment. Here, one can find Centres of Excellence covering complex areas such as the design and manufacture of high reliability printed circuit boards, the design of special purpose military antennae, small arms weapons testing, military vehicle mobility and RAM-D testing, and the adaptation of computers to the solution of military technical problems. New and innovative thinking will be required to meet the oncoming challenge of land warfare equipment acquisitions such as; low level air defence radar, thermal imaging, the electromagnetic compatibility problems associated with the movement of large metal masses, and computer aided design, manufacturing, and engineering (CAD/CAM/CAE).

The present level of excellence has been achieved only after ten years of hard work and detailed planning. The LETE family is diverse, spanning many disciplines and a broad technological base as seen in the various articles elsewhere in this Bulletin. Yet our numbers are small. Our thrust to remain technically current must reflect a commitment to continuous research and the maintenance of consistently high standards.

During a decade which saw a push towards the closure of military test establishments in favour of the industrial sector, LETE COs, from Duke to McEachern pressed forward, confident in the knowledge that they were leading an establishment essential to the land forces of the CF. In retrospect, their efforts were monumental.

It took six years of study by NDHQ staffs and private consultants to determine that Canadian industry is incapable of fulfilling the roles and tasks assigned to LETE. I think it is safe to say that over half of Col McEachern's time here was spent in developing that study. But he was not alone! Without the considerable efforts of (then) Col HR Wheatley of C Eval, LCols W. Roueche and FA Hlohovsky of DLES 4, the staff at DCER and representatives from DREE, the job might have been well nigh impossible.

Proposed sites and alternative options were examined, culminating in the visit to LETE on 4 Nov 81 by the Hon Donald J Johnston, MP, then President of the Treasury Board. Shortly thereafter, approval-in-principle to proceed with LETE modernization in the present locations was announced, and architects for various phases of the project were selected.

Since that time we have been working with eager anticipation towards occupying new facilities at the Orleans site, and towards a revitalization of our capability at Building M-23, in Rockcliffe. While leaning towards present requirements, planning has included provisions for flexibility and adaptability in the certain knowledge of continuing technological change.

LETE staff are professional. Given the resources available at any moment in time, they have invariably produced work of a significantly high standard. As a result of their efforts Canada enjoys a meaningful stature in many areas of military technology. With new and revitalized facilities we can expect an exciting future, indeed!

LAND ENGINEERING TEST ESTABLISHMENT - TODAY

by Capt JCM Giguere

STATUS

LETE is a unit of the Canadian Forces embodied in the Regular Force and assigned to NDHQ/ADM(Mat) Group.

COMMAND AND CONTROL

The officer holding the senior military appointment in ADM(Mat) Group exercises command over LETE. Functional control is exercised by ADM(Mat) through DGLEM/DLES.

ROLE

The role of LETE is to provide third line engineering services.

FUNCTIONS

The functions evolving from the role of LETE are to:

- conduct or arrange to have conducted and report on engineering tests and evaluations of land forces equipment, equipment in support of aerospace functions which is designated as Airfield Ground Support Equipment and certain electrical and electronic equipment associated with Maritime and ground-based aerospace support systems;
- make technical studies and practical verifications of new ideas and concepts;
- investigate failures and malfunctions of equipment in service, and design remedies, where necessary;
- from block communication system concepts, design circuits, assemblies, electronic packages, interfaces and minor equipment, then breadboard, prototype, produce engineering models and preproduction samples, including associated technical information for the data package as required;
- from stated requirements, design, and fabricate and produce technical data packages for tactical vehicle kits;
- produce as directed limited numbers of equipments where military in-house or industrial manufacture is not feasible;
- conduct or assist in demonstrations or displays of equiment, components or material;
- obtain equipments, components or material for tests, evaluations and technical studies. This may include: demand on the CF supply system; loan from industry and other government departments or through Standardization Loan Agreements; manufacture in LETE workshops, rental or purchase;
- control and account for equipments, components and material;
- provide maintenance services for land forces special electronic equipment until normal repair agencies are trained and equipped for the task: and
- provide facilities and services for other Government Departments and Civilian Agencies as directed.

ORGANIZATION

LETE is deployed in four locations in the Ottawa area, as shown in Fig. 1. The main site is the Orleans Proving Grounds, 12 km East of Ottawa; Bldg. M-23 is located with the NRC on Montreal Road; the Stolport is in CFB Ottawa (N); and there is a small detachment in the Bourque Memorial Building in downtown Ottawa. The unit has an establishment of 176, composed of 90 military and 86 civilian personnel.

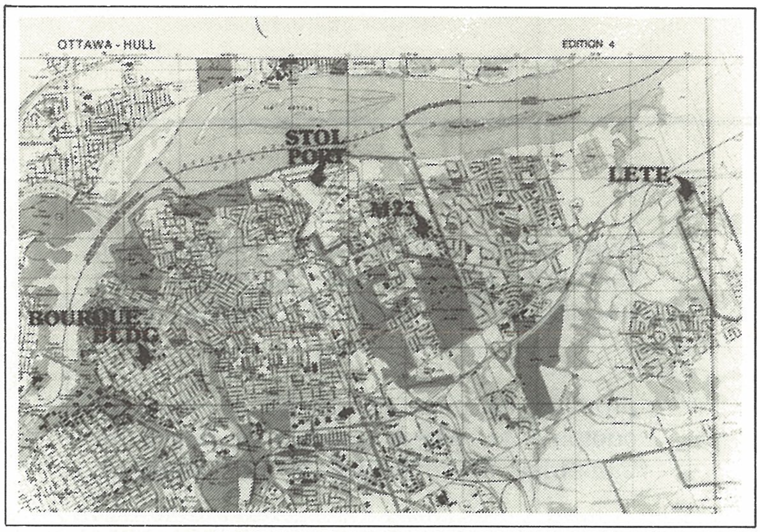


Figure 1: LETE is Deployed in Four Locations in the Ottawa Area

The establishment is organized on a functional basis in four squadrons as shown in Fig. 2: Plans, Control and Administration (PCA Sqn); Mobile Systems Engineering (M Sqn); Land Tactical Electrical and Armament Engineering (E Sqn); and Logistics Support (Log Sp Sqn). As the name implies, PCA Sqn has three areas of responsibility: technical administration undertaken by the Engineering Operations Centre at M-23; personnel administration by the Orderly Room at the Proving Grounds; and training coordination by the OC PCA's Sqn Office, also at the Proving Grounds.

The primary role of M Sqn is engineering tests. This involves the evaluation and failure investigation of Land Forces vehicles and equipment, aircraft and airfield ground support equipment, and field engineer equipment. The infrastructure caters for equipment maintenance, fabrication, test instrumentation and photography. Other specialized facilities developed during the Second World War at the Orleans Proving Grounds are such that LETE is unique among testing establishments. For example, the tracks, slopes and special courses are excellent for testing military vehicles while the hills, swamps, wooded areas, open fields, rock and sand exemplify the natural terrain expected by the CF in actual operations. These features, with over 16 km of track and slopes to a 60% gradient, facilitate tests such as maximum speed, acceleration, braking, traction, power, fuel consumption, turning radius, durability and centre of gravity. Stability is evaluated on a tilt table, amphibious vehicles in a wading tank, and suspension and articulation tests on courses of Granite Blocks, Belgian Pavé or Concrete Sinewave.

E Sqn, based at M-23, houses the electronic laboratories and related facilities. These laboratories prototype land tactical electronic, communication and electrical devices, equipment and systems, and develop the kits required for installation in wheeled and tracked vehicles and shelters. System checks, including electromagnetic compatibility measurements, engineering evaluation of contractor provided equipment, and failure investigations of in-service equipments are undertaken.

The armament engineering section has an office in M-23, with a workshop and a 100 m small arms range at the Proving Grounds, as well as facilities for the evaluation of weapons and weapon systems up to and including 40 mm. The laboratories have a range of emergency support facilities, and a printed circuit board and plating facility is established and fully equipped.

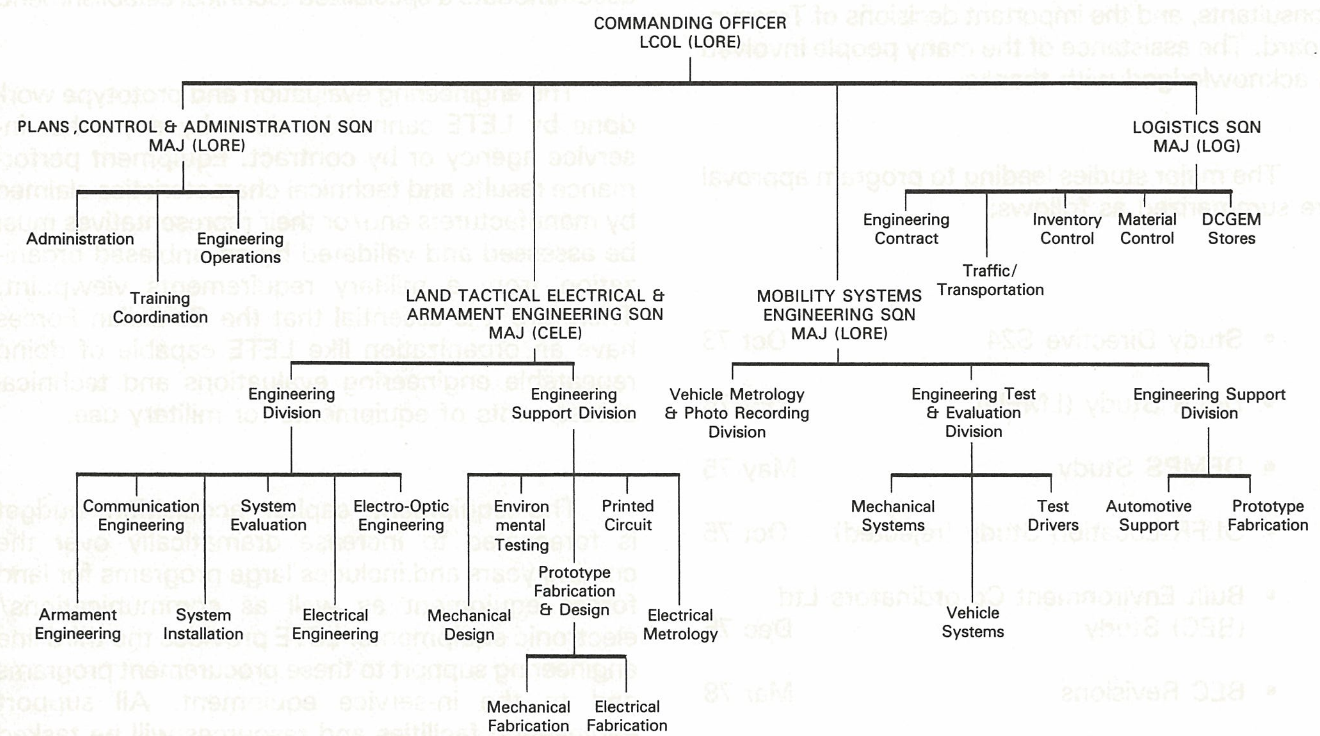
The environmental laboratory, including a walk-in humidity controlled cold chamber, gives LETE the capability of conducting climatic and durability tests such as, vibration, rain, altitude, acceleration, drop, shake, shock loading, salt spray and thermal shock. A small mechanical design section is also established within E Sqn.

LETE's main prototype and fabrication facility, part of E Sqn, is housed in M-23 as well. The mechanical section is equipped to carry out all aspects of sheet metal work and machine tooling including general machining, tool and die, heat treatment and all types of welding. There is a limited plastic and rubber moulding capability. Items fabricated in the mechanical section are finished by the paint shop to provide the required surface protection and appearance. The electrical section fabricates electrical/electronic circuits in accordance with designs developed by LETE. Transformers and coils can be wound to special requirements. Specialized cable and wiring harnesses are also fabricated.

Log Sp Sqn, located at the Stolport, controls, accounts and warehouses the stores used on projects. They also purchase project material. The detachment in the Bourque Building holds the clothing and equipment for test and evaluation by DCGEM. In addition, it holds the Canadian Forces master sealed patterns for uniforms and accoutrements, and related specifications.

EDITORIAL NOTE:
An overview of LETE since its formation during the Second World War is being prepared for a future edition of this Technical Bulletin.

Figure 2: LETE Organization Chart



LETE DEVELOPMENT PLAN

by Capt RA Peterson

INTRODUCTION

LETE is poised to begin a $27,000,000 construction and refurbishment program which will upgrade the Unit to the forward edge of engineering technology, in support of the CF. This stage has been reached after a decade of intensive effort by numerous interested agencies over and above LETE staff, including ADM(Mat), CEM, DGLEM, outside consultants, and the important decisions of Treasury Board. The assistance of the many people involved is acknowledged with thanks.

The major studies leading to program approval are summarized as follows:

• Study Directive S24	Oct 73
• DFLR Study (LMED)	Oct 74
• DEMPS Study	May 75
• DLFR Location Study (rejected)	Oct 75
• Built Environment Co-ordinators Ltd (BEC) Study	Dec 75
• BEC Revisions	Mar 78
• Location Study (rejected)	Jun 80
• Treasury Board (TB) Submission	Dec 80
• DND/DREE Study (Relocation of LETE) (rejected)	Jun 81
• Treasury Board (TB) Submission	Aug 81
• Treasury Board (TB) President Visit	Nov 4 81
• Treasury Board (TB) Level 1 Approval	Nov 6 81

A great deal of energy has been expended since November 1981. It is anticipated that the TB Level 2 submission will be made in January 1984.

BACKGROUND

The current accommodation occupied by LETE is old, dilapidated and badly in need of replacement. Many of the present buildings have a life expectancy of less than five years. In addition, building layouts are inefficient as they are Second World War temporary buildings and were not designed to accommodate a specialized technical establishment.

The engineering evaluation and prototype work done by LETE cannot be done by any other in-service agency or by contract. Equipment performance results and technical characteristics claimed by manufacturers and/or their representatives must be assessed and validated by an unbiased organization from a military requirements viewpoint. Therefore it is essential that the Canadian Forces have an organization like LETE capable of doing repeatable engineering evaluations and technical assessments of equipments for military use.

The equipment capital acquisition budget is forecasted to increase dramatically over the coming years and includes large programs for land forces equipment as well as communications/electronic equipments. LETE provides the third line engineering support to these procurement programs and to the in-service equipment. All support engineering facilities and resources will be tasked to the upper limits to meet these demands. Therefore, it is essential that the facilities at LETE be modernized.

INTERIM ACCOMMODATION

In order to accommodate construction of the new main building at the Orleans site all existing buildings located on the east side of the entrance road will be demolished in June 1984 (Figure 1). M Sqn personnel will be housed in the existing buildings and in rental trailers on the west side of the entrance road. E Sqn Armt personnel will have a temporary facility at the Connaught Range as well as some workshop space at Orleans. A Logistics Support Squadron detachment will occupy rental office and warehouse space on the Orleans site. And finally, Logistics Support Squadron and Program Control Administration Squadron will be

housed in rental accommodation in an industrial park approximately 7 km from the Orleans site.

Following completion of the new main building, all the buildings on the west side of the entrance road except two will be demolished. These exceptions include Bldg 401 which will be occupied by the M Sqn Photo Section and a new 250 m² building which will eventually be retrofitted to handle EMC/EMI testing.

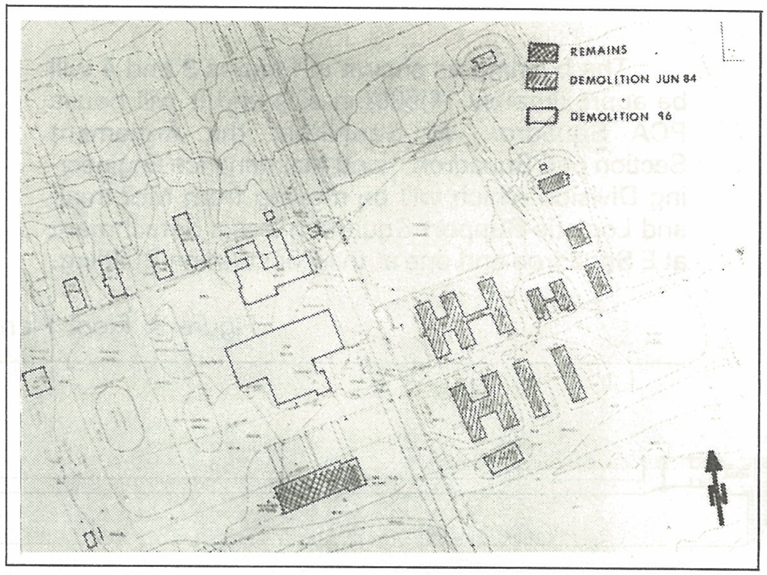


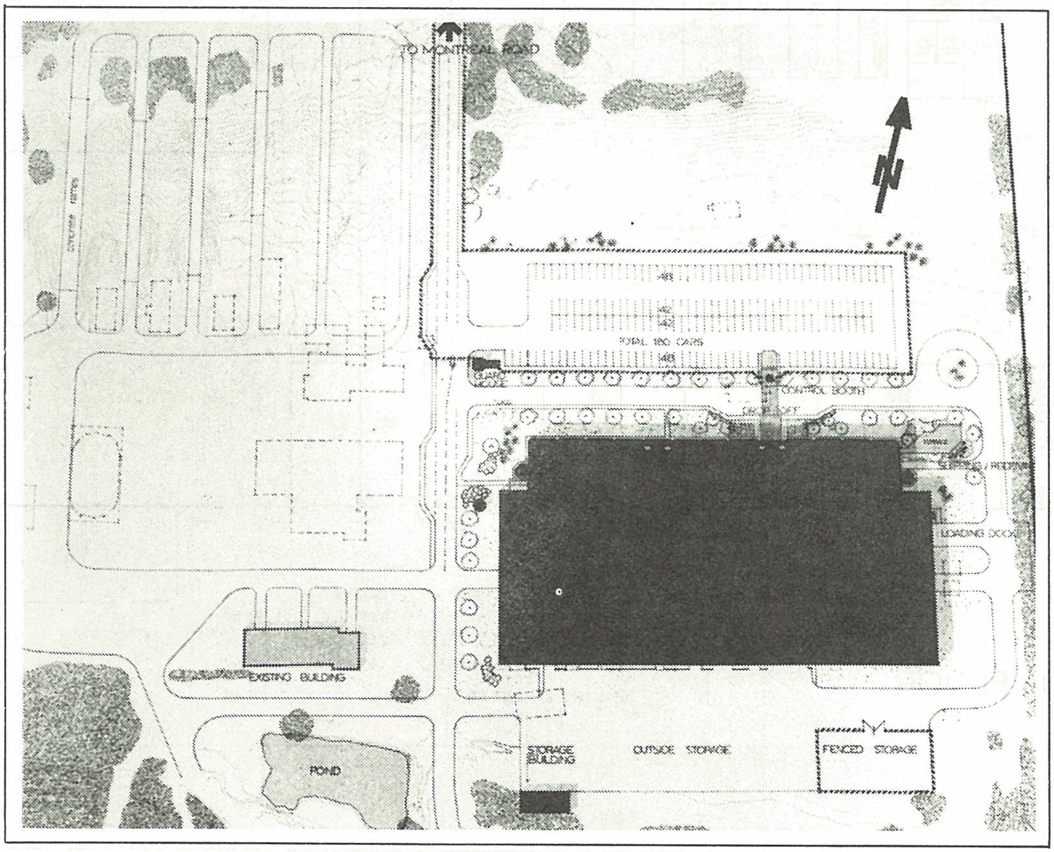
Figure 1: Existing Buildings at Orleans

MAJOR PROJECTS

LETE Development consists of three major design and construction projects at the Orleans site — the main building, a range facility and outside services.

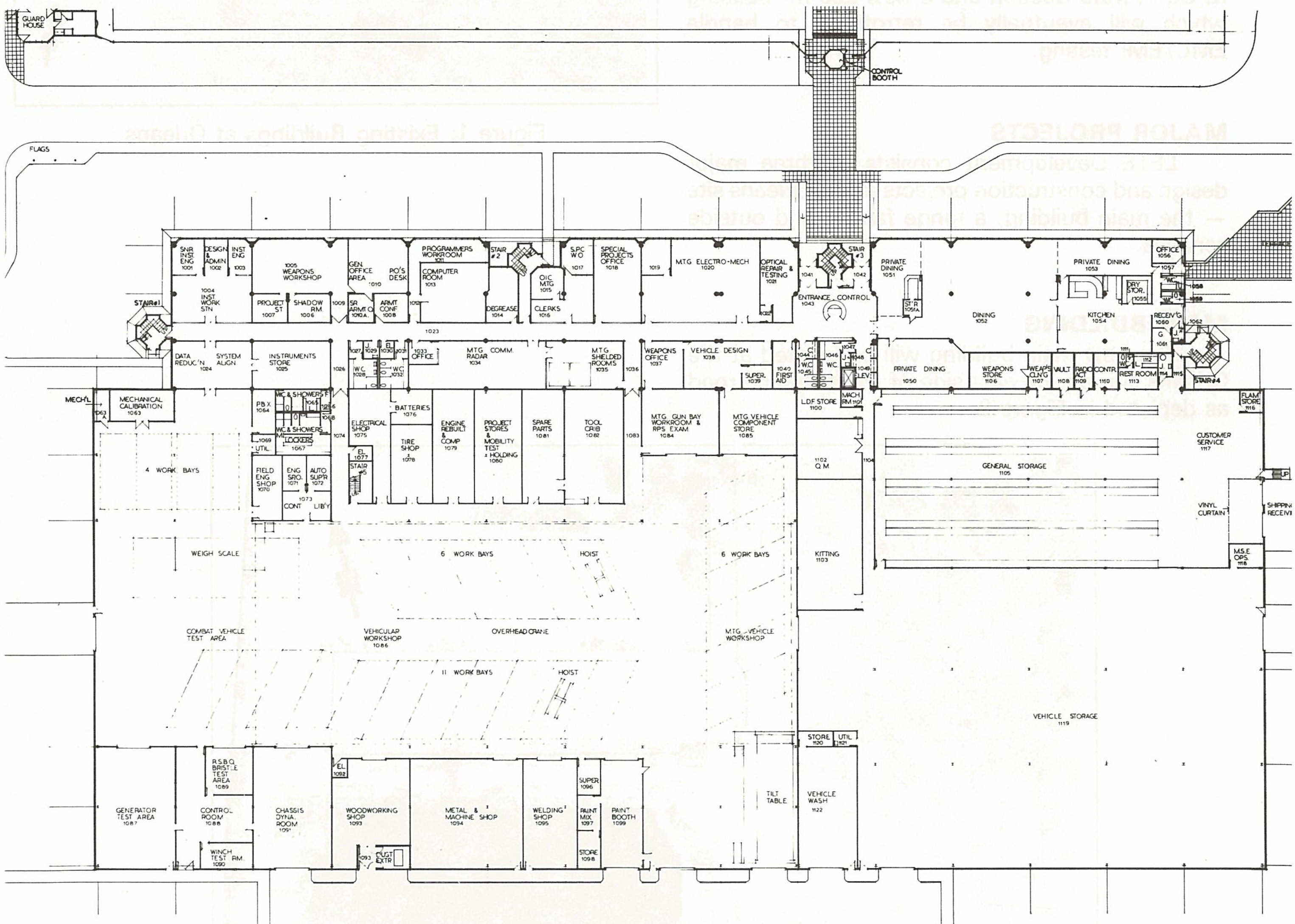
MAIN BUILDING

The new main building will be located at the Orleans site on the east side of the entrance road as depicted in Figure 2.



The building as shown in Figures 3 and 4 will be approximately 14,500² in size and it will house PCA Squadron, M Squadron, the Armament Section of E Squadron, Land Maintenance Engineering Division which will be moving from Montreal, and Logistic Support Squadron less a detachment at E Squadron and one at the Constitution Building. E Squadron will remain in Building M-23 at the NRC Complex on Montreal Road. Several test facilities such as the tilt table and weigh scales, which are currently located in the test track area, will be positioned in the main building. This will allow year round accessibility to Unit Test Officers.

Figure 3: Floor Plan — Main Building



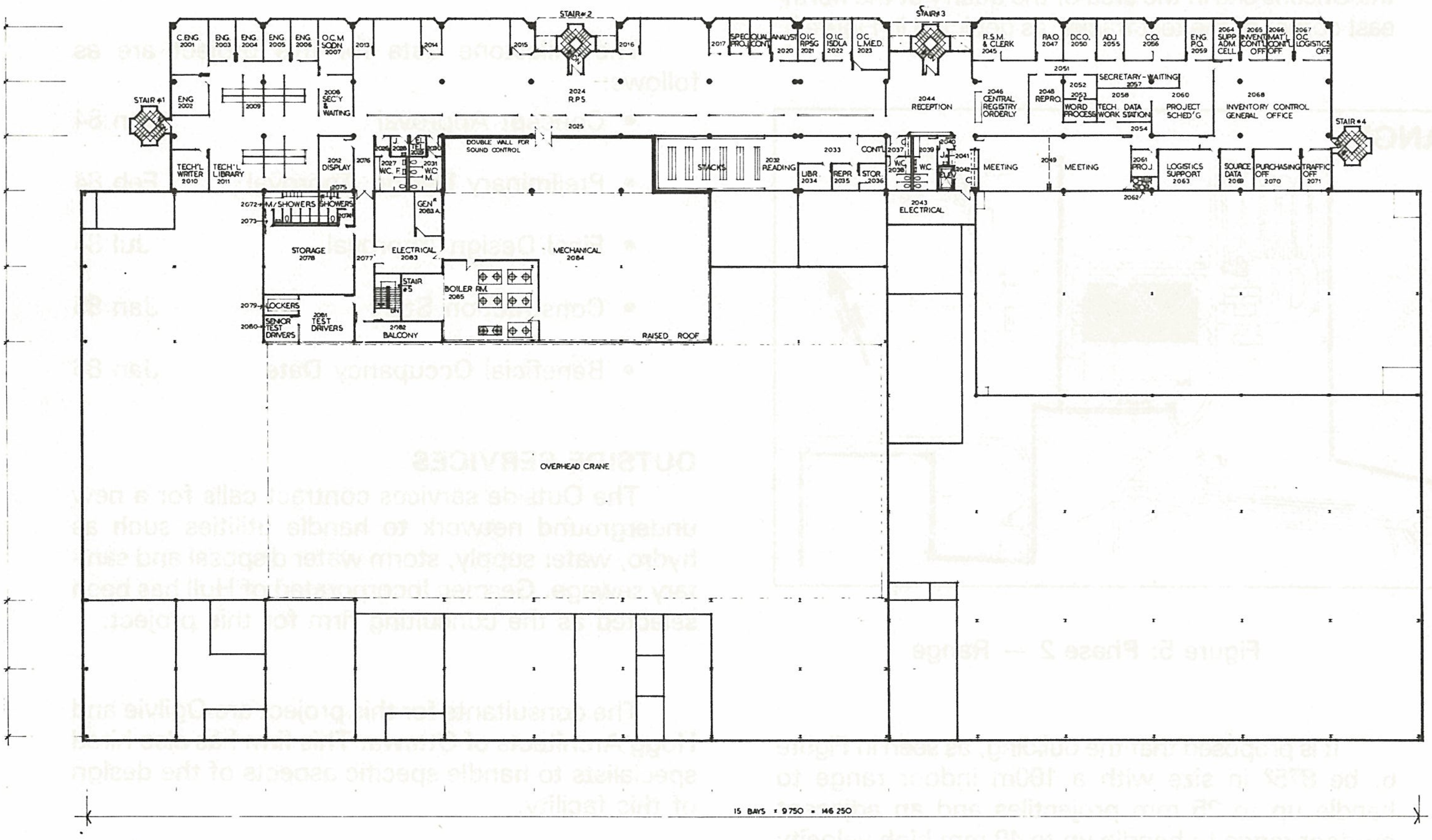
GROUND FLOOR	OFFICE :	2 403 m²	
	SHOPS :	8 881 m²	11 284 m²
SECOND FLOOR	OFFICE :	2 403 m²	
	SERVICES :	804 m²	3 207 m²
TOTAL GROSS FLOOR AREA :			14 491 m²

GROUND FLOOR

SCALE 1: 200

The consultants involved in the design phase of the main building are Schoeler and Heaton, Ottawa. They in turn have hired their own sub-consultants for requirements such as cost control, the engineering disciplines and interior design control.

Figure 4: Floor Plan — Main Building



SECOND FLOOR
SCALE 1 : 200

The milestone data for this project are as follows:

- Concept Approved — Nov 82
- Preliminary Design Approved — Feb 83
- Final Design Approved — Feb 84
- Contract Awarded — May 84
- Demolition/Construction Start — Jun 84
- Beneficial Occupancy Date — Sep 85

RANGE

The Range facility (Phase 2) will be located at the Orleans site in the area of the quarry at the north-east corner of the test tracks, as depicted in Figure 5.

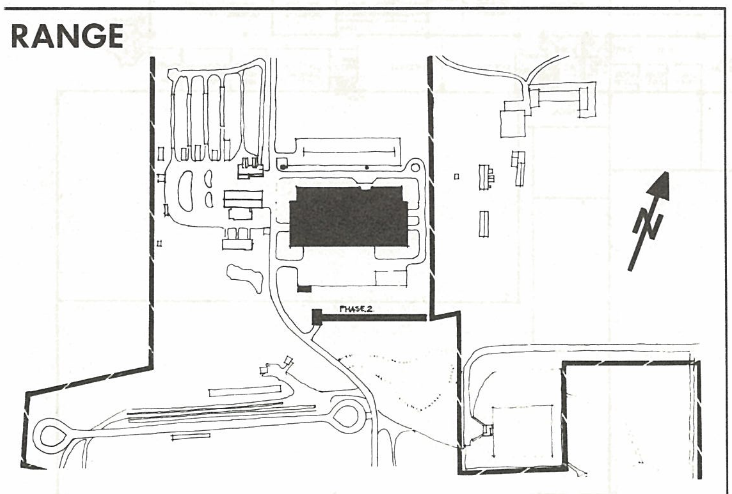


Figure 5: Phase 2 — Range

It is proposed that the building, as seen in Figure 6, be 875^2 in size with a 100m indoor range to handle up to 25 mm projectiles and an adjacent outdoor range to handle up to 40 mm high velocity projectiles. There will also be a vehicle room to handle such items as the Leopard Tank or the AVGP, a gun room to house the Glide Mount, soft recoil mount and ballistic pendulum. There will also be space provided for offices, workshop and observation room.

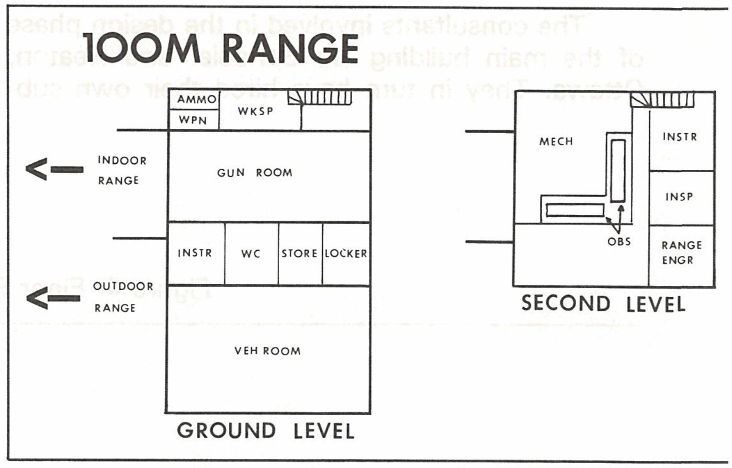


Figure 6: Floor Plan — Range

The milestone data for this project are as follows:

- Concept Approval — Jan 84
- Preliminary Design Approval — Feb 84
- Final Design Approval — Jul 84
- Construction Start — Jan 85
- Beneficial Occupancy Date — Jan 86

OUTSIDE SERVICES

The Outside services contract calls for a new underground network to handle utilities such as hydro, water supply, storm water disposal and sanitary sewage. Gesmec Incorporated of Hull has been selected as the consulting firm for this project.

The consultants for this project are Ogilvie and Hogg Architects of Ottawa. This firm has also hired specialists to handle specific aspects of the design of this facility.

The milestone data for this project are as follows:

- Preliminary Design Approval — Oct 83
- Final Design Approval — Jan 84
- Contract Award — Mar 84
- Completion — Aug 84

LAND ENGINEERING OPERATIONS CENTRE (ENG OPS)

by Capt JCM Giguere

INTRODUCTION

LETE is a field unit of ADM(Mat) and, as such, is tasked in accordance with CFTO C-02-006-006/AG-001. Fig. 1 depicts the flow of a typical project. In brief, the NDHQ Sponsor prepares his task and selects the appropriate project priority from Annex E of the CFTO. It is then forwarded to DLES 4-2, the LETE tasking authority at NDHQ, where it is reviewed and, if approved, passed to LETE Ops Centre for action. All tasking correspondence is channelled through DLES 4-2 and LETE Eng Ops to ensure complete documentation, proper staffing, and effective project control.

ROLE OF THE ENG OPS

LETE receives an average of 300 taskings per year from DLES 4-2, on behalf of the OPI directorates. These are assigned to specialty centres within the two LETE line squadrons, depending on the areas of knowledge required. The primary role of Eng Ops is project control.

Eng Ops provides technical´ administrative support to the Engineering Squadrons. This is in areas that are common to both squadrons, where a central agency is the most efficient for human resource utilization. Functions here include recording all incoming tasks; acting as liaison between the LETE and NDHQ project officers, and assisting in the writing and publication of test reports.

The Centre maintains the LETE Operational Information System (LOIS), a data base used by both LETE and NDHQ as a project management aid. The Unit reference Library is also the responsibility of the Centre. The library contains reference books, manuals, textbooks and current trade publications. Reference material is also obtained from outside agencies; eg. the Land Technical Library, NDHQ Library, CISTI (NRC reference library), to aid project officers in their work.

An important responsibility of the Centre is preparation of test reports. These are drafted with the aid of technical writers (located with the two major squadrons for efficiency) and then processed in proper format, approved, published and forwarded to the NDHQ OPI for action.

Annually, a report is prepared of the projects in hand and completed during the past year.

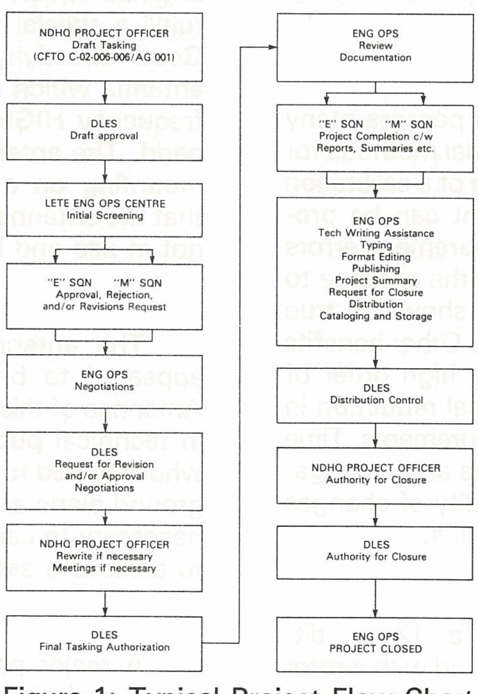


Figure 1: Typical Project Flow Chart

RADIO ANTENNA DEVELOPMENT

By Mr. Cyril Bowering

BACKGROUND

An important part of the work undertaken by LETE E Squadron, Communication Section, is the design, development and evaluation of a wide range of radio antennae. The main object of this work has been the development of antennae for Canadian Land Forces operating in the tactical environment. These devices typically operate in the VHF or UHF band and are designed for vehicle or portable mast mounting.

INSTRUMENTATION

LETE antenna design facilities include a full range of modern test equipment which has been greatly enhanced by the acquisition of a Hewlett Packard Model 8707 automatic network analyzer. This is a computer controllable system, operating from 100 Khz to 1.3 Ghz, which characterizes the reflection or transmission loss, of two or three terminal networks, in terms of magnitude and phase. A control program is employed which translates these parameters to the more familiar impedance, admittance and VSWR values. Results are displayed on a CRT and numerically during manual operation and can be either plotted or printed out while under computer control. At the time of its delivery this was the only 8707 system installed in Canada.

Automatic measuring systems possess many advantages compared to conventional methods for antenna testing. For example, by use of a calibration procedure the automatic equipment can be programmed to compensate for measurement errors introduced by the cable connecting the antenna to the test set so that printed results show the true impedance at the antenna terminals. Other benefits derived from this system include a high order of resolution and accuracy and a radical reduction in the time required for a series of measurements. Time is of particular importance in antenna and propagation measurements due to the rapidity of changes in atmospheric and ground conditions.

Other test facilities include a 12 m tilt-over/crank-up mast which can be fitted with a rotor for radiation pattern measurements and a rotatable platform which is designed to support vehicles as large as 1 1/4 ton capacity so that pattern measurements of complete installation can be made (see Figures 1 and 2).

RECENT ANTENNA DEVELOPMENTS

LETE has developed a VHF ground plane antenna which has been adopted as standard issue for the Canadian Land Forces. This antenna is currently in production by a commercial contractor. The new ground plan antenna covers the 30-76 Mhz band with only three length changes compared to 30 discrete lengths used with the previous antenna.

The antenna shown mounted on the mast in Figure 1 is a LETE designed UHF broadband antenna. Intended primarily for vehicular use the antenna element is a flexible sleeve moulded within a rubber sheath and is capable of withstanding the abuse encountered when driving through brush without protection.

A further example of a recent LETE antenna development is a VHF directional broadband antenna which was designed and constructed to fulfill a special field communication requirement. Good directivity and gain were required in an antenna which could accept 1,000 watts of radio frequency HIGH power through the tactical VHF band. The antenna was required to be capable of mounting on a 1¼ ton vehicle. It is necessary that the antenna should present a low profile when not in use and be capable of rapid erection.

The antenna type best suited to this role appeared to be a log-periodic monopole array. Antennae of this general configuration are described in technical publications, however, none seemed wholly suited to the requirement due to the limited ground plane area available. It was, consequently, necessary to carry out a full experimental program to achieve a satisfactory design.

A major part of the experimental work was conducted with small scale models of the antenna.

High frequency modelling techniques are commonly used for antenna investigations. This procedure makes it possible to evaluate a design using small, low cost easily assembled models which can be accommodated within the laboratory. The physical scaling ratio bears a simple inverse relationship to the operating frequency; so that, halving the size of the antenna doubles its frequency. During this development, quarter scale models were employed with an operating frequency in the UHF band.

At Figure 3 the network analyzer is shown being used to measure the impedance of the ¼ scale model of the final antenna configuration. The full sized version of the antenna is shown in Figure 4 erected for operation and in Figures 5 and 6 it is shown folded for transit or camouflage purposes.

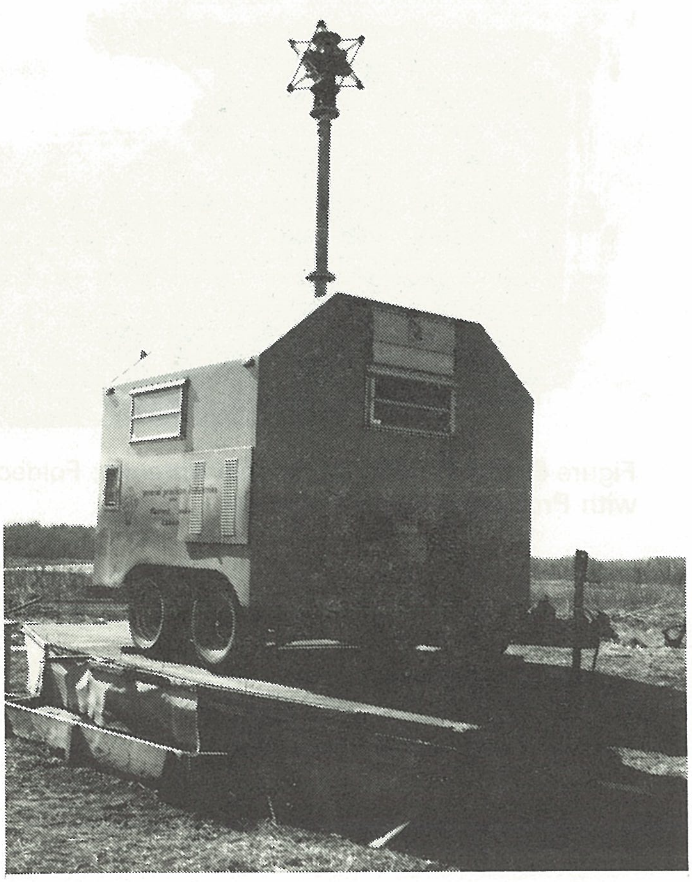


Figure 2: Rotatable Platform with Prototype Radio Direction Finding System under Test

Erection time of this antenna is less than 10 seconds. Currently, the antenna is with a field signals unit who are conducting an operational evaluation.

A number of novel electrical and mechanical features are incorporated in the design of both the directional broadband and the UHF broadband antenna and patent applications have been filed.

SUMMARY

LETE has the expertise, experience, instrumentation and fabrication facilities to undertake a variety of antenna related tasks including original design. A number of LETE developed VHF and UHF antennae are currently in use by Canadian Forces.

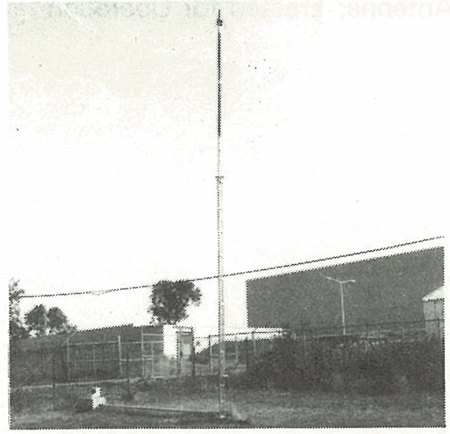


Figure 1: Tilt-over/Crank-up Mast with Flexible UHF Broadband Antenna Mounted

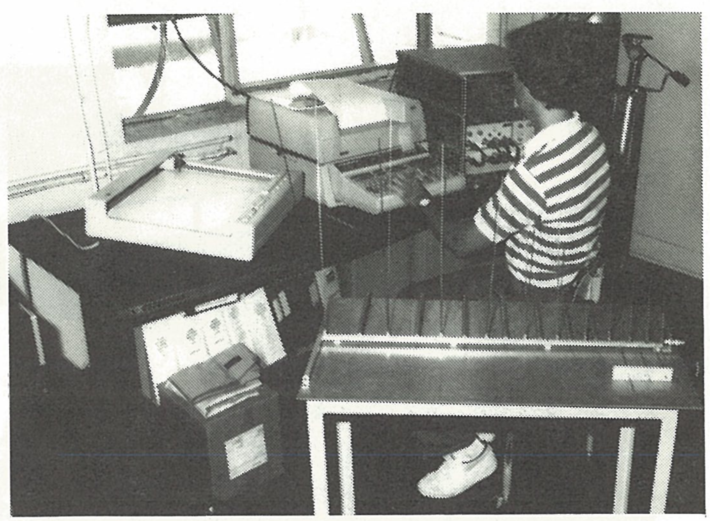


Figure 3: Mr. G. Sirois using HP 8707 Automatic Network Analyzer System to Test ¼ Scale Model of Log Periodic Monopole Antenna

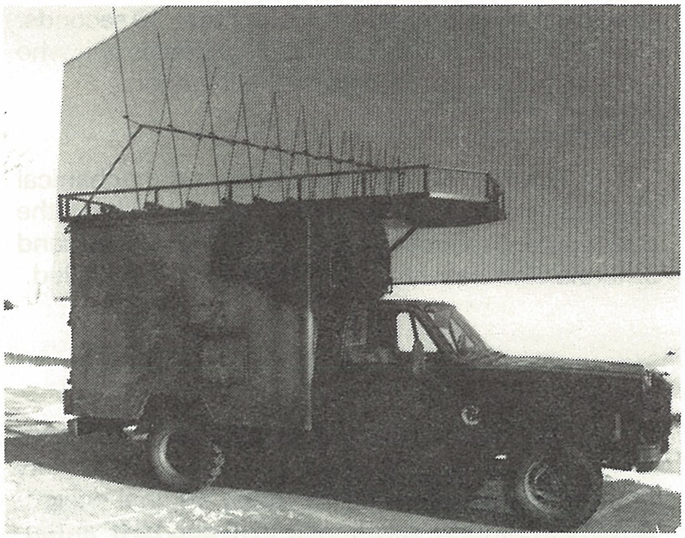


Figure 4: Full Scale Prototype of Log Periodic Monopole Antenna; Erected for Operation

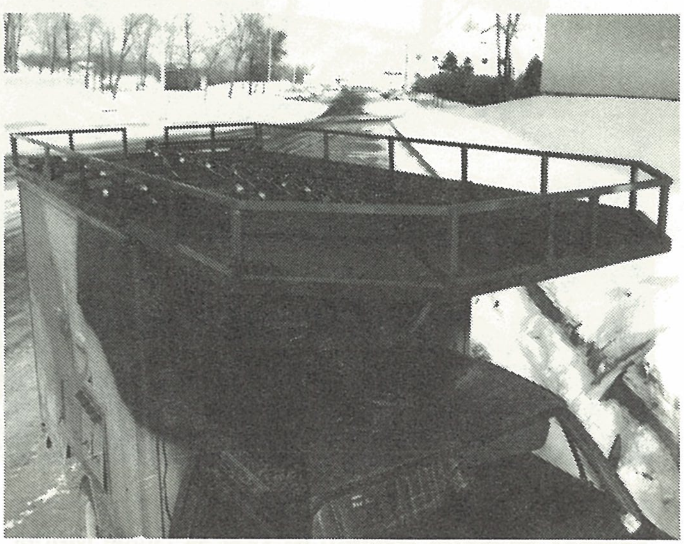


Figure 5: Log Periodic Monopole Antenna; Folded

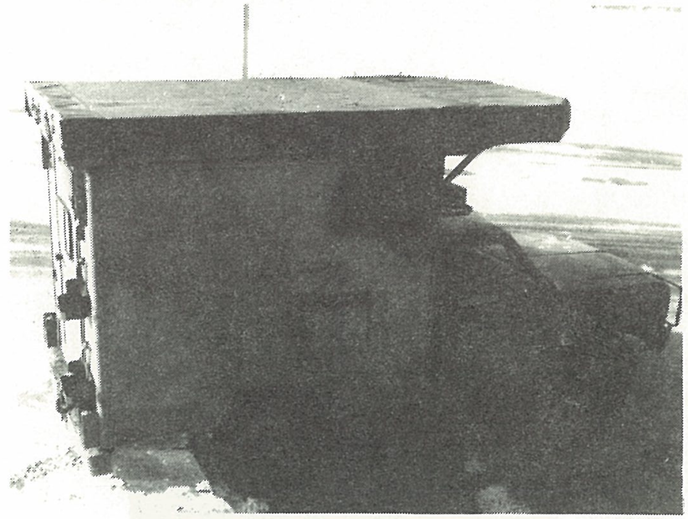


Figure 6: Log Periodic Monopole Antenna; Folded with Protective Cover in Place

LETE INSTRUMENTED TEST RANGE

By Capt R.C. Beggs, PPCLI

BACKGROUND

LETE entered the 1980s with an ad hoc 100 m test range. It had a British electronic shot position indicator, a set of photo-electric velocity screens and a steel weapon mount table located in a small temporary structure on a concrete pad.

In 1981, representatives of the Small Arms Replacement Program (SARP) initiated a program with LETE to upgrade the range facilities in order to conduct extensive engineering tests in support of the SARP program. The aim was to build a fully instrumented, computer controlled small arms testing facility. Subordinate to the aim, it was decided to support a similar reconstruction on a range at PETE, Nicolet, and to have both ranges identical in equipment and interoperable.

SARP required a range capable of year-round activity which would acquire data from test-firing the SARP contender weapons. Data was to be acquired as the result of NATO standard testing in the areas of precision, velocity, rate-of-fire, and yaw. In addition, endurance and RAM data was to be acquired as a product of firing test weapons to as many as 30,000 rounds per rifle. Recognizing an in-service use of 500-750 rounds/year, this represents 40-60 years of wear.

To further compound the problem, a decision was made to establish a SARP data base containing all trial data, from engineering and user trials, and all other technical information gained during the SARP project definition phase. The aim of the data base is to be a pool of technical information which will be available to the LCMM during the implementation and in-service phases. To accomplish this aim standardization of input data formats and interoperability of range computers with the DLAEEM Honeywell Level 6 computer was demanded.

RANGE DESCRIPTION

The most impressive single piece of electronic equipment installed on the range is the ACCUBAR electronic shot position indicator. It utilizes two aluminum rods set at right angles to each other to detect the position of a round in space by analyzing the shock wave. With a precision of ± 2 mm and a capability to store data from up to 512 shots fired singly or in automatic mode, it is a far cry from measuring shot holes on paper with a ruler.

Velocity is determined by a double set of sensing screens. Each set has a start and a stop screen set out at pre-determined distances. An electronic counter measures the time displacement and the computer converts the time versus distance to velocity. The duplicate set-up provides a second velocity for comparison and indication of equipment failure.

A custom built yaw target has brought a tedious measurement into the 20th Century. Rounds are fired at a rate of one round per second into a paper screen moving 10 cm per second. A closed circuit TV camera scans the paper and the test supervisor reads a monitor for a real time subjective statement on the presence or absence of yaw.

Round counting and rate of fire are determined by detecting muzzle blast on firing with a ballistic microphone. Signals are fed to the computer which counts against the time base producing either round count or rate of fire.

The weapon mounts were rebuilt for the SARP program. The main precision mount is a 500 kg mount constructed by LETE using a design provided by the UK for the NATO New Family Small Arms Program. This mount, the GILDA mount, permits the weapon to move only along the axis of the base when it is fired. Thus, changes in the location of fall of shot are a factor of weapon wear and not of the weapon mount.

Complementing the precision mount is the soft recoil mount which secures the weapon to the extent that fired rounds fall into the sand butts, but which allows a full expression of weapon recoil. This mount is used for the bulk of the firing during the accumulation of RAM data.

The heart of the range system is a Hewlett Packard 9845B computer. The computer controls the electrical firing of all weapons to ensure consistency of testing method and co-ordinates the testing according to the pre-programmed test sequence. However, the test supervisor retains full command of the system.

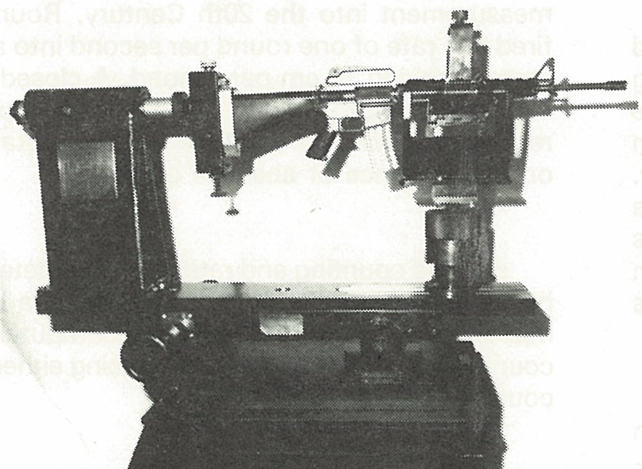
The computer collates pre-firing data, fires the weapons, reads the instruments and collates all acquired data. At the end of each firing day, that day's data is transmitted by telephone through a modem to the main data base computer.

The LETE instrumented range has been a success. The first main SARP task lasted 14 months through all weather conditions and fired 410,000 rounds from 20 candidate weapons. The acquired data has assisted in providing the level of input required to convince Treasury Board to agree to spend $500M on a weapon system.

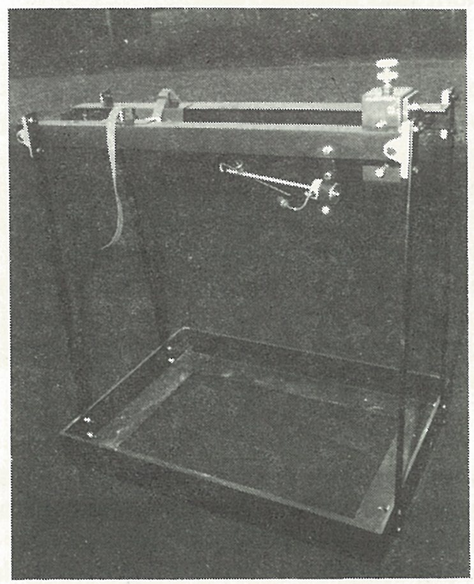
FUTURE

At the moment the LETE instrumented test range is a re-built Second World War outdoor facility. Plans are at an advanced stage to relocate the range in to a custom designed 100 m indoor range at the LETE Orleans site. Proposals for the range, at a cost of $1.5M, should be submitted to Treasury Board by the end of 1984 looking toward an opening two years later.

The LETE instrumented test range is an ideal example of modern technology being adapted and used to provide cost effective, engineering detail in support of a major capital acquisition project.



GILDA precision mount



Soft recoil mount

Hewlett Packard 9845B computer

ELECTRO-OPTICS LAB CAPABILITY

By Mr. R. Schwartz

BACKGROUND

The Electro-Optics Section is the newest addition to LETE E Sqn's Engineering Division. It was recognized nearly ten years ago that a facility to test and evaluate electro-optical systems would be required to test the new generation of night-sights, low light level devices, and laser systems.

In 1979 LETE began development of its electro-optic capability. In consultation with DLAEEM and the Visionics group at DREV the general requirements to meet expected NDHQ taskings were identified.

A detailed study was carried out to identify applicable measurement standards, specifications, methods and procedures involved. Specific test instrumentation needed was then identified and procurement action taken. The physical parameters of the laboratory were identified and three candidate areas in building M-23 NRC compound were evaluated with assistance from the NRC building research group who performed vibrational measurement and analysis. A best compromise choice was made and a detailed requirements specification was drawn up and presented to Base CE for necessary construction work. Construction commenced in May 80. The instrumentation selection and procurement processes were sequential activities phased over a three year period to the end of 1982, with a facility meeting the planned objectives.

CURRENT CAPABILITIES OF THE ELECTRO-OPTICS LAB

The laboratory consists of a single 3.6 m x 7.2 m room capable of providing a dark room light level below that of overcast star light (i.e. $< 10^{-5}$ lux). Temperature control to $\pm 2°C$ is possible and a reasonably clean room environment can be maintained.

Instrumentation is available for the following electro-optic system and device measurements:

- Optical Transfer Function (OTF) to NATO Standard STANAG NO 4161 (The primary measurement being Modulation Transfer Function (MTF);
- Signal Transfer Function (STF);
- Noise Limited Resolution (NLR);
- Gain;
- Resolution;
- Equivalent Background Illumination (EBI);
- Bright Flash Exposure Response;
- Laser Output Power (0.4 to 1.5 nm);
- Laser Beam Diameter;
- Laser Beam Divergence;
- Laser Pulse Width;
- Field of View;
- Magnification;
- Focal Length;
- Collimation;
- Photometric (such as display screen brightness);
- Radiometric (visible and near infra-red);
- Spectral (visible and near infra-red).

Typical taskings which have been undertaken and successfully completed are:

- First generation 18mm Image Intensifier Tube (IIT) susceptibility to damage by bright light flashes.
- First generation 18mm IIT evaluation compared to the current Canadian Forces IIT.

- Comparative evaluation of two new types of single IIT goggles made by Pilkington and Wild with the current AN/PVS5A two tube Canadian Forces goggles.

CONCLUSIONS

Establishing an electro-optics capability was a long term development. The current facilities are quite modest with specialization in only two areas of electro-optics namely IIT and laser devices. Proposed future development of the lab will include a thermal imaging capability. LETE is currently engaged in a technical study to identify the requirements for entering the thermal field.

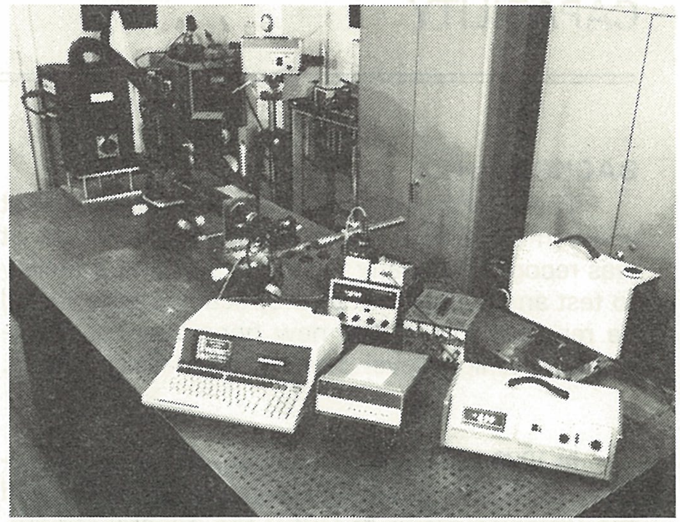


Figure 1: Lab Set Up for MTF Measurement

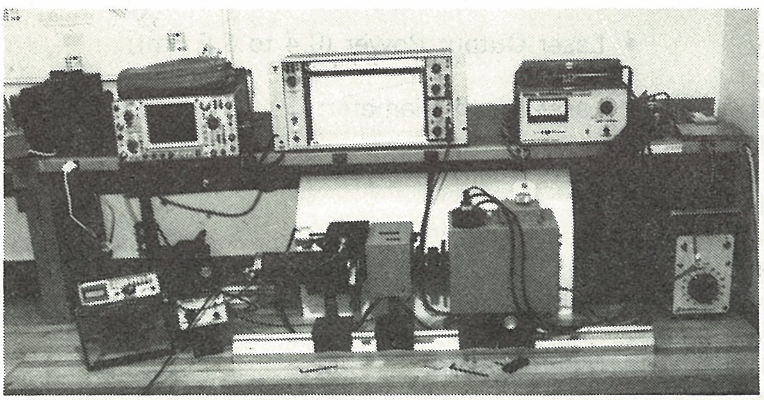


Figure 2: Lab Set Up Used to Measure Spectral Response

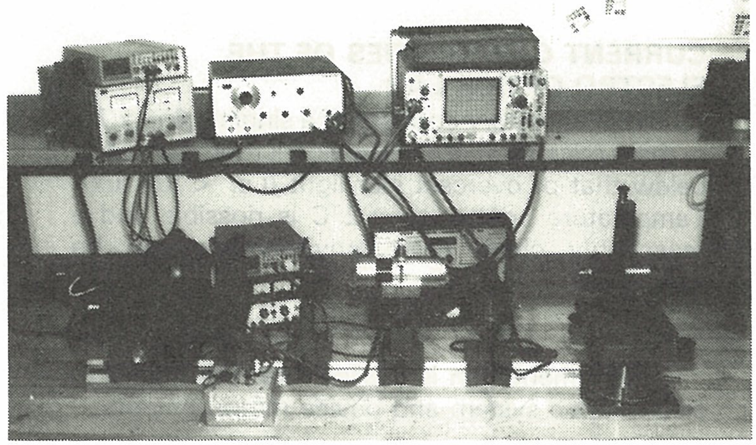


Figure 3: Lab Set Up for Testing Image Tube's Response to Bright Flashes

LASER RANGEFINDER SIMULATOR FOR LEOPARD C1 MBT

by Gary J Mears, CET

Leopard C1 MBT Gunnery Training on an indoor miniature range (IMR) using the Laser Rangefinder (LRF) and Integrated Fire Control System (IFCS) has not been possible to date.

To resolve this training problem, LETE was tasked to conduct a feasibility study to include, if possible, a breadboard demonstration model of a simulator that would allow training indoors with simulation of full LRF and IFCS capabilities. The desirable characteristics of the system would include:

- Instructor input of target information with data storage and single action recall;
- The control of pop-up targets; and
- Elimination of the bracketeer.
  (The bracketeer is required on current training to adjust the weapon simulator mount for each change in range)

A study of the LRF and IFCS circuitry and interconnection scheme indicated that a suitable system could be developed based on the following:

- Replacing the laser head with a unit that would simulate the operation without firing of the laser;
- Replacing the range information fed to the ballistic computer with range information scaled for compatibility with the IMR;
- Monitoring of the Gunner's use of the system to produce the desired real time response in full simulation of system usage;
- Interfacing to the LRF and IFCS at existing interconnection points, making Leopard system modifications unnecessary; and
- Producing a keyboard and display interface for instructor input and system control.

A breadboard demonstration unit was designed and fabricated on the basis of the study. The unit was put together by integration of off the shelf and in-house designed circuitry. A microprocessor based system was chosen to provide the desired flexibility in a compact package. The breadboard demonstration system provided the following functions:

a. Instructor interface;

- Entry of target identification numbers for up to 99 targets;
- Entry of target range and second echo range for each of these targets (the LRF can record two ranges);
- Entry of desired ammunition type for each target engagement;
- Entry of target type for each engagement (targets can be fixed, pop-up, or mobile);
- Entry of IMR defined numbers for mobile and pop-up targets (this was included to allow for the subsequent inclusion of a target control system as part of the simulator system);
- Recall of entered data by target number for each training engagement;

b. Laser Rangefinder interface;

This interface connects to the laser power supply, replacing the laser head of the LRF. It simulates the necessary signals in real time response to the Gunner's actions, allowing full use of the LRF without actually firing the laser.

c. Ballistic Computer Interface;

This interface connects to the computer in a "T" type arrangement, allowing for the replacement of range information and monitoring of Gunner's actions. Through this arrangement, full use of the

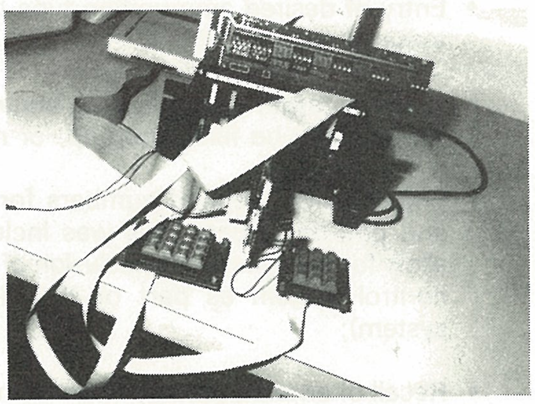
IFCS is accomplished and scaled range information fed to the computer, eliminating the requirement for a bracketeer.

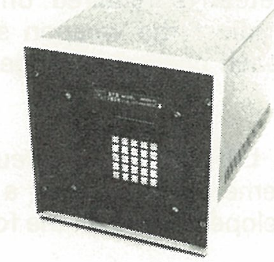
The breadboard demonstration unit has been successfully displayed on the Leopard C1 MBT at LETE and on the training turrets at CFB Gagetown. The initial positive response has resulted in a request to produce three user trial models of a complete system, to include:

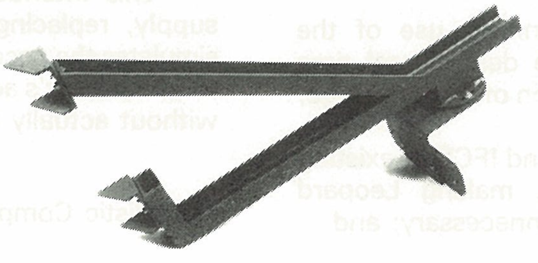
- Instructor's console as defined by the breadboard demonstration unit;
- Target control system to interface to the console and provide control of pop-up and mobile targets;
- Weapon simulator mounting bracket. This is required to relocate the weapon simulator for use with the LRF sight and allow initial positioning and range zeroing; and
- Parallax correction lens for the LRF sight for indoor short range use.

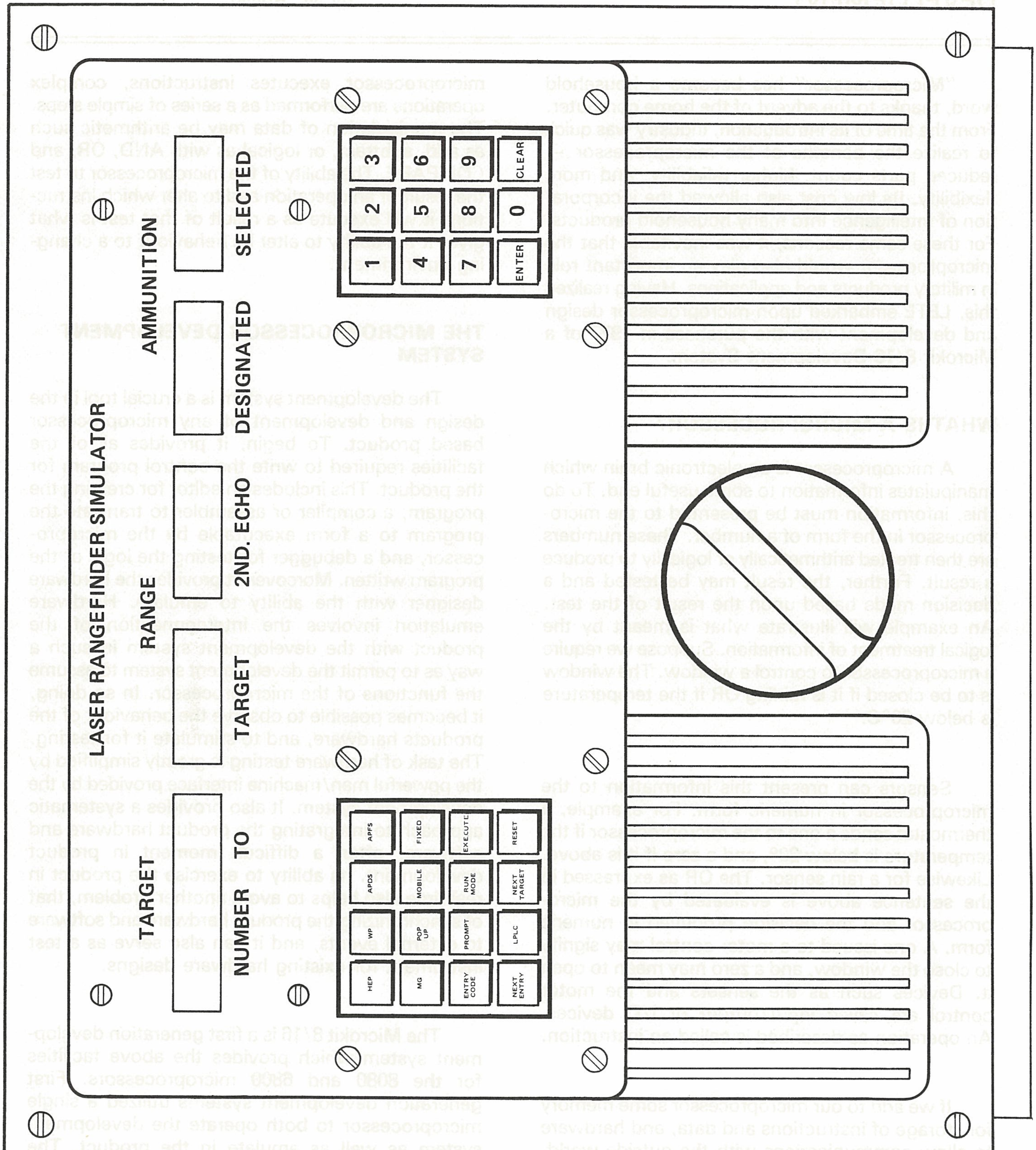
The system design has been completed and is now in various stages of fabrication and testing. The user trial models incorporate the functions of the breadboard demonstration unit with the additional items indicated above. The Instructor's console incorporates an expanded keyboard and display system, and an interface for the target controller. It is housed in a ruggedized package with a provision for tilting the system to accommodate the position of the instructor. This user trial model will, on instructor command, recall target information, activate the selected pop-up or mobile target, control the speed of mobile targets, and provide the necessary range and control information for the LRF and IFCS.

Action is now underway to go ahead with production of sufficient units to provide the simulator capability for all CF training turrets.


USER TRIAL MODEL DEVELOPMENT
DISPLAY AND KEYBOARD TESTING


LASER RANGEFINDER SIMULATOR
BREADBOARD PROTOTYPE


WEAPON SIMULATOR BRACKET FOR USE WITH LRS ON IMR



LRS USER TRIAL MODEL FRONT PANEL

MICROPROCESSOR DEVELOPMENT

by NC Boivin

"Microprocessor" has become a household word, thanks to the advent of the home computer. From the time of its introduction, Industry was quick to realize the benefits of the microprocessor — reduced parts count, higher reliability, and more flexibility. Its low cost also allowed the incorporation of intelligence into many household products. For these same reasons, it was inevitable that the microprocessor would also play an important role in military products and applications. Having realized this, LETE embarked upon microprocessor design and development with the purchase in 1977 of a Microkit 8/16 Development System.

WHAT IS A MICROPROCESSOR?

A microprocessor is an electronic brain which manipulates information to some useful end. To do this, information must be presented to the microprocessor in the form of a number. These numbers are then treated arithmetically or logically to produce a result. Further, the result may be tested and a decision made based upon the result of the test. An example will illustrate what is meant by the logical treatment of information. Suppose we require a microprocessor to control a window. The window is to be closed if it is raining OR if the temperature is below 20°C.

Sensors can present this information to the microprocessor in numeric form. For example, a thermostat sends a one to the microprocessor if the temperature is below 20°, and a zero if it is above. Likewise for a rain sensor. The OR as expressed in the sentence above is evaluated by the microprocessor and the decision produced in numeric form. A one issued to a motor control may signify to close the window, and a zero may mean to open it. Devices such as the sensors and the motor control are called input/output or I/O devices. An operation as described is called an instruction.

If we add to our microprocessor some memory for storage of instructions and data, and hardware to allow communications with the outside world, we now have a microcomputer. A collection of instructions is called a program. Each instruction manipulates data in some simple manner. As the microprocessor executes instructions, complex operations are performed as a series of simple steps. The manipulation of data may be arithmetic such as add, subtract, or logical as with AND, OR, and COMPARE. The ability of the microprocessor to test the result of an operation and to alter which instructions it will execute as a result of that test is what gives it the ability to alter its behaviour to a changing environment.

THE MICROPROCESSOR DEVELOPMENT SYSTEM

The development system is a crucial tool in the design and development of any microprocessor based product. To begin, it provides all of the facilities required to write the control program for the product. This includes an editor for creating the program, a compiler or assembler to translate the program to a form executable by the microprocessor, and a debugger for testing the logic of the program written. Moreover, it provides the hardware designer with the ability to emulate. Hardware emulation involves the interconnection of the product with the development system in such a way as to permit the development system to assume the functions of the microprocessor. In so doing, it becomes possible to observe the behaviour of the products hardware, and to stimulate it for testing. The task of hardware testing is greatly simplified by the powerful man/machine interface provided by the development system. It also provides a systematic approach to integrating the product hardware and software, often a difficult moment in product development. Its ability to exercise the product in real time also helps to avoid another problem, that of synchronizing the product hardware and software to external events, and it can also serve as a test instrument for existing hardware designs.

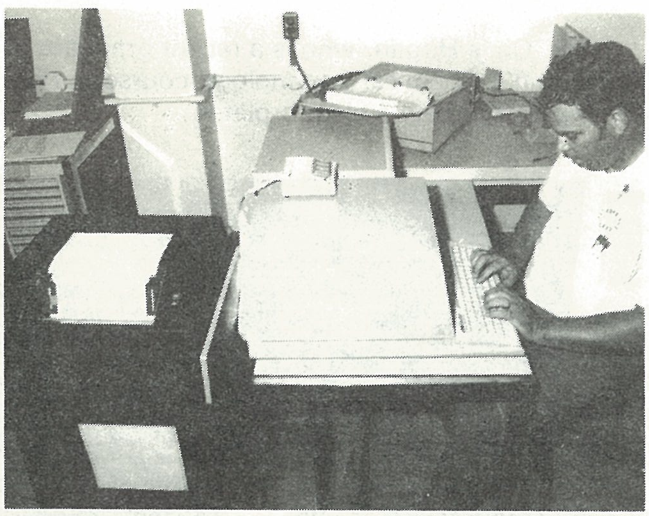
The Microkit 8/16 is a first generation development system which provides the above facilities for the 8080 and 6800 microprocessors. First generation development systems utilized a single microprocessor to both operate the development system as well as emulate in the product. The signal bus of the product became an extension of the development systems bus. This created some compromises as certain facilities such as interrupts

had to be shared between the product and the system. Care had to be taken to prevent memory in the product from being "mapped" over memory in the development system, and of course, while emulating, the development system was not available to do other functions such as editing. Second and third generation development systems overcame these problems by using several microprocessors simultaneously. Additionally, logic analysis of the product bus is performed by these systems.

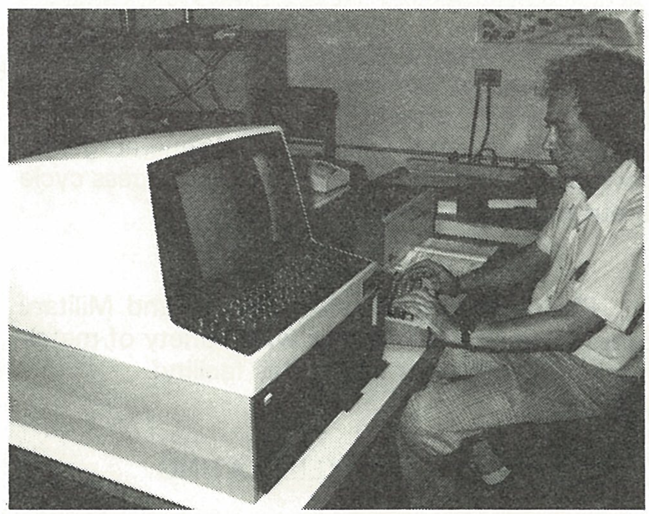
In 1982 two (Genrad Series 2300) third generation development systems were purchased by LETE. These systems have extended our capability to include the Z-80, 6802, 6809, and 8085 microprocessors. With the aid of these systems, several microprocessor based equipments have been designed and developed, including the DDN/IMS interface (6800), The Comm Data Return Link (8080), the Laser Rangefinder Simulator (Z-80) and the Shot Rate Counter (NSC 800). Support for other microprocessors will be added as the need arises.

CONCLUSIONS

The acquisition of three microprocessor development systems by LETE has assured the engineering laboratories at E Sqn the capability of testing, interfacing, design and development of microprocessor-based military products. Along with the experience in microprocessor design gained over the past six years, it also assures that our staff will meet the future needs of the Canadian Forces in high-technology electronics.



Gary Mears of E Sqn using the Genrod Series 2300 Development System to debug the prototype Laser Rangefinder Simulator



NC Boivin performs software editing for the Communications Data Return Link on the Futuredata 8/16 Development System

NEW ELECTRO-PLATING FACILITY

by Mr. Keith Rodie

The history of our electro-plating and metal finishing facility dates back to the formation of LETE during the Second World War. This facility served consistently for the past 40 years in its original configuration. Understandably, it recently became necessary to upgrade both the equipment and processing technologies to meet present day requirements.

The new Electro-Plating Facility was officially opened on 9 June, 1983. The system was designed as a prototype facility having a high degree of built-in flexibility to handle plating of ferrous and non-ferrous metal products fabricated by both the in-house Machining and Sheet Metal Sections.

Our processing capacity is based on material geometry and surface area. Each tasking, therefore, is evaluated separately with regard to processing time and required finish. As a general guide, however, 0.18 m^2 of surface area per process cycle is our maximum limit.

Plating to the following Federal and Military Specifications indicates the wide variety of metal-finishing capabilities within this facility:

FEDERAL:

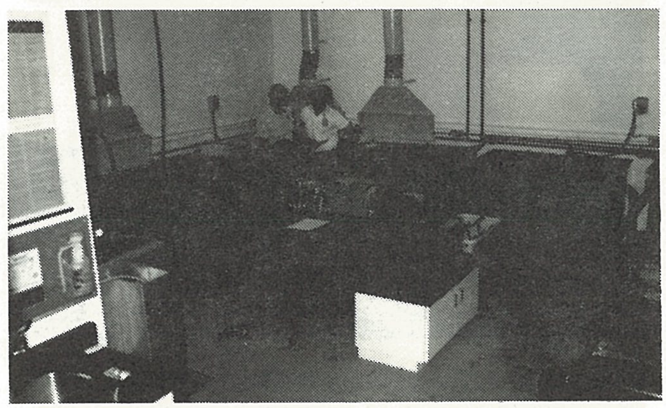
- QQ-N-290 - NICKEL PLATING
- QQ-S-365 - SILVER PLATING
- QQ-S-571 - SOLDER AND TIN ALLOYS PLATING
- QQ-Z-325 - ZINC ELECTRO-PLATING

MILITARY:

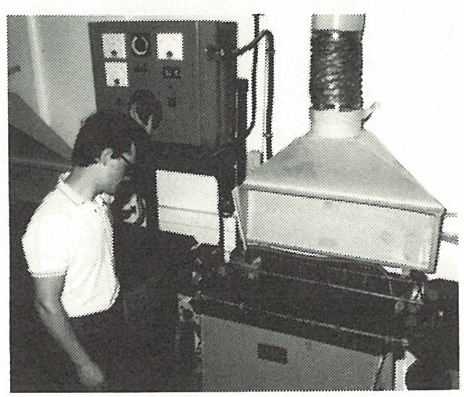
- MIL-C-5541 - CHEMICAL CONVERSIONS COATINGS ON ALUMINUM AND ALLOYS
- MIL-A-8625 - ANODIC COATINGS ON ALUMINUM AND ALLOYS
- MIL-T-10727 - TIN PLATING
- MIL-T-12879 - CHROMATES FOR ZINC DEPOSITS PREPAINT TREATMENT
- MIL-C-14550 - COPPER PLATING
- MIL-P-16232 - PHOSPHATE COATINGS, HEAVY, ZINC BASE (FOR FERROUS METALS)
- MIL-C-26074 - ELECTROLESS NICKEL

LETE within its Printed Circuit Board and Electro-plating Section has many years of experience in all areas of electro-plating.

Mr. Chris Hogan, who is a recent graduate of Algonquin's Chemical Technology course is now serving as the Unit's electro-plater.



Mr. Rodie and Mr. Hogan discussing process procedures



Mr. Hogan operating zinc electro-plating equipment

INFORMATION CORNER

Given the rapid growth in ADP and MIS technologies, a regular column in the LORE Technical Bulletin is topical and well warranted. This column is sponsored by LCol AR Gillis, DLES 5, and will feature articles concerning MIS and RAM-D subjects.

The first article is about BSAMMS. The DLES 5-4 project team of Maj JC Giroux, Capt B Cantin and CWO KS Matacheskie is rapidly concluding the functional design, leading to implementation.

BSAMMS was reported briefly in LORE Technical Bulletin, Issue 4/78. Maj (now LCol) Gillis mentioned that the introduction of BSAMMS will remove the delays in data acquisition by LOMMIS and provide field units with timely and accurate information. The subject was presented next by Capt (now Maj) Giroux in Issue 1/81.

The aim of BSAMMS is to strengthen the operation and management of OE workshops. The computer will assist in the documentation and planning of work and will provide timely information to maintenance commanders at all levels.

From the LOMMIS viewpoints, BSAMMS will be a source of accurate and timely input data. It will also produce, at local level, some of the reports currently handled by LOMMIS, thus removing the delays inherent in a system using a central computer.

Some concern has been voiced re the possibility of eliminating clerical jobs when BSAMMS is introduced. Be assured that, if this situation occurs, the jobs affected will be those least rewarding and the personnel involved will be given more challenging employment within the workshop.

This project will affect the future of everyone employed in maintenance and thus needs the support of all LORE personnel.

WHAT IS HAPPENING WITH BSAMMS

by Capt Bruno Cantin

The time has come to provide you with a SITREP on the activities of the Base Static Automated Maintenance Management System (BSAMMS) project. This article will include a brief history of BSAMMS and describe its objectives and related sub-systems.

HISTORY

As you probably know, BSAMMS has been around for over seven years. A prototype was started in Petawawa in 1977 by Maj (Retd) Gerry Masuda; this prototype proved that providing automated assistance to workshops has many benefits.

Early in 1980, Maj Jean-Claude Giroux was tasked to field a national BSAMMS. After visiting several base maintenace organizations, he realized that due to numerous differences and omissions in procedures, implementation of a national BSAMMS would be very difficult, if not impossible. He voiced his concern about hasty implementation and was tasked, in conjunction with DLES 2, to review and recommend branch policy on workshop management and operations.

MAINTENANCE IMPROVEMENT PLAN (MIP)

The decision to define branch policy on static operations resulted in the creation of the MIP. The objectives of this plan are:

a. to develop a set of procedures and forms to assist maintenance commanders in operating LORE workshops; and

b. to automate those appropriate procedures.

Many advantages can be gained by introducing the manual system prior to deploying BSAMMS:

a. it will permit further validation of policy and testing of procedures and forms;

b. it will serve as a formalized method of operation until the introduction of BSAMMS;

c. it will serve as a manual back-up for BSAMMS; and

d. it will train all maintenance personnel in a more formalized method of operation to facilitate the introduction of BSAMMS.

By the time this article is published, the procedures and forms for the MIP will have been completed and tested at the Base Maintenance Section in CFB Winnipeg. The publications concerning this manual approach, to be called the Manual Maintenance Management System (MMMS) will be issued in 1984 prior to first implementation, scheduled for late 1984.

BSAMMS UPDATE

Besides running the MMMS trial, in conjunction with DLES 2, the BSAMMS project team completed the detailed definition of the procedures to be automated. The procedures developed are grouped into sub-systems as illustrated in Fig. 1.

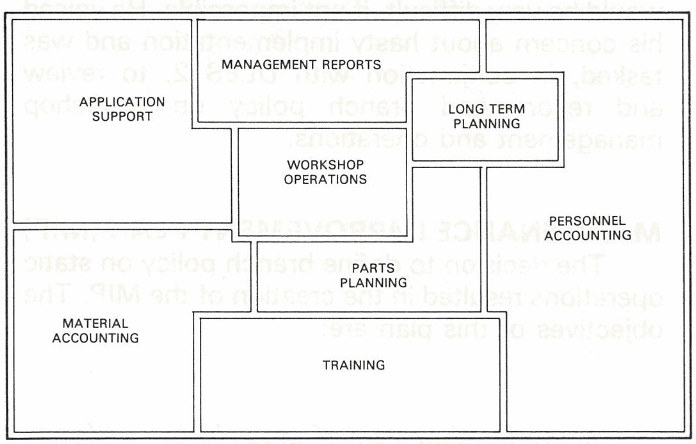


Figure 1: BSAMMS WITH ITS SUB-SYSTEMS

These sub-systems have been identified to achieve the following high-level objectives:

a. to support workshop management;

b. to support workshop operations; and

c. to support workshop administration.

The long term planning sub-system is designed to simulate the effect of future events on the level of service provided by the workshop and on the efficiency of the workshop. The computer will assist the control officer in assessing the workload for the next year. From the estimates of workload and a set of options involving manning, leave and the use of contract funds, the sub-system will calculate the resulting level of service. The workshop commander will thus be able to take action to prevent some of the foreseen problems or at least to advise superior authorities of forthcoming problems.

The management report sub-system will provide a set of reports (routine/exception/query) to enable maintenance commanders to improve the service provided and/or to make better use of resources.

The workshop operations sub-system will document the flow of each job through the workshop. It will assist in planning and controlling the workload. It will assist the parts coordinator in obtaining parts and the control officer in managing contract funds.

The parts planning sub-system will assist the scaling NCO in evaluating the requirements for parts in the future and in monitoring the accuracy of these forecasts. This sub-system is being developed in close cooperation with the CFSS Upgrade Project.

The personnel accounting sub-system will assist maintenance commanders at all levels in documenting and evaluating the utilization of their manpower. The sub-system will also assist the sub-section commander in forecasting the near term manhours available. This information is required by the workshop operation sub-system to schedule the workload.

The application support sub-system is a housekeeping module that will be used to update the tables used by the system. For example, the system will be used to input and update the various tables used by LOMMIS.

The training sub-system will assist the training officer/WO/Sgt and section commander to determine training required, maintain training records, and provide information on training.

The material accounting sub-system will keep an inventory of specialized tools and technical publications used in the workshop.

Even though BSAMMS is a system by itself, it is also viewed as a sub-system within larger systems. This point is illustrated in Fig. 2.

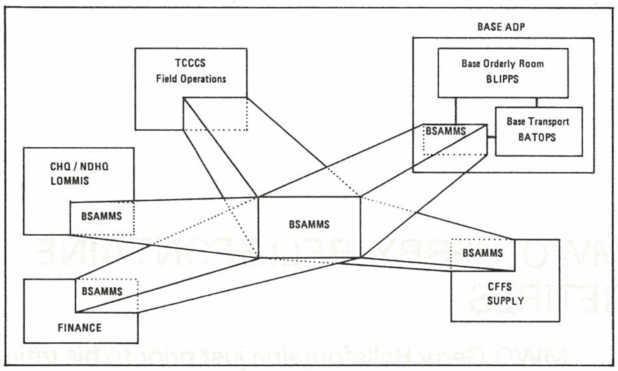


FIGURE 2: BSAMMS AS SUB-SYSTEM OF LARGER SYSTEMS

An important part of the development involves resolving the functional and ADP interfaces with these systems.

BSAMMS and the other ADP systems operating at base level come under the umbrella of the Base ADP Project. This project will provide economies of scale in purchasing equipment, and coordination in the selection of equipment. There are two sets of milestones influencing the delivery of BSAMMS:

BSAMMS MILESTONES

System External Specification (SES) Completed	Mar 84
Programming Completed	Sep 85
First Delivery	Oct 85

HARDWARE MILESTONES

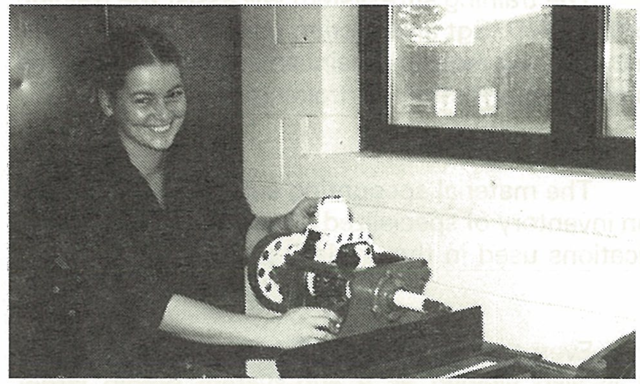
Program Development Plan (PDP)	Mar 84
Program Change Proposal (PCP)	Feb 85
Treasury Board Approval	Aug 85
First Delivery Hardware	Dec 86
Hardware Delivery Completed	Feb 88

It is planned to obtain funds in the PDP to purchase suitable computing equipment to allow the early testing of BSAMMS programs on at least one site, before the selected hardware becomes available in Dec. 86. The delay from fall 85 to early 87 is because of the requirements of the Defence Services Program (DSP). Every effort will be made to limit this long delay and/or to provide an interim partly automated MMMS version.

The BSAMMS project is alive and progressing as well as possible given DSP timing constraints. The system is being developed by maintainers for maintainers. The team welcomes questions and suggestions. We are only a phone call away: NDHQ - 995-3551.

ARTE ET MARTE

focus on people



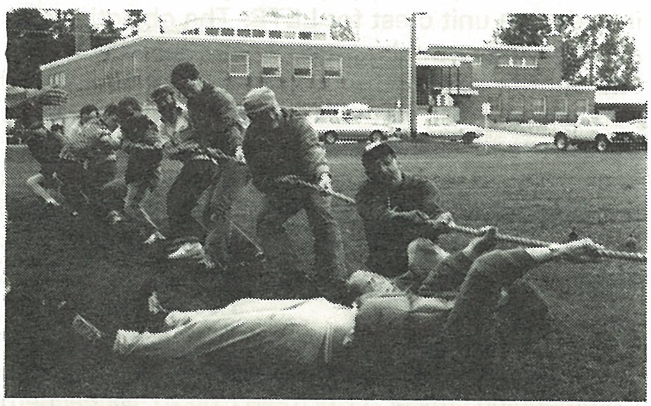
MWO GERRY BELLEFONTAINE RETIRES

MWO Gerry Bellefontaine just prior to his retirement was presented with the second clasp to his CD by BGen JGR Doucet, DGLEM and Branch Adviser, during a recent visit to CFB Shearwater. MWO Bellefontaine originally hails from Halifax and enrolled in the Army in 1949 as a Trooper with the RCD. He can currently be considered as one of the longest serving members associated with that famous Regiment which celebrated its 100th birthday in the fall of 1983. Gerry took a brief leave of absence after his initial enrolment, but re-enrolled in 1953 as a VEH TECH with RCEME (later LORE and now LEME) and has served in various capacities and positions in Germany twice, Kingston, Borden, Petawawa, Gagetown, Ottawa, UNEF 1 and 2, just to mention a few postings, before coming to Shearwater in 1980. Gerry's career spans some 34+ years. He has decided to leave the service and join a Consulting Firm in Ottawa which is currently providing service to Bombardier on the new ¼ Ton replacement vehicle, the "ILTIS". Gerry is probably one of the best known MWOs within the Branch and will be remembered for his contributions both technically and administratively, for his experience as a NIMROD, and his famous story of the "Ball Base Game". The Branch and Base Maintenance Land, Shearwater, wish to extend best wishes and lots of success in his new endeavour.

sports stop

Front Row (L to R)
Butch Boucher, Chris Corriveau, Barry Moony, Pat Galbraith, Fred Praught

Back Row
Pete Clark, Marty Martin, Stu Hines, Bud Milloy, Mike Lorrette, Brian Stewart, Gary Corrigan (Bat Boy) Brent Corrigan



OOPS CWO Paisley sabotaging the AACSE Course "Tug of War Team".

Front Row (L to R)
Steve Martin, Vince Deschamp, Pete Clark, Walley Fletcher

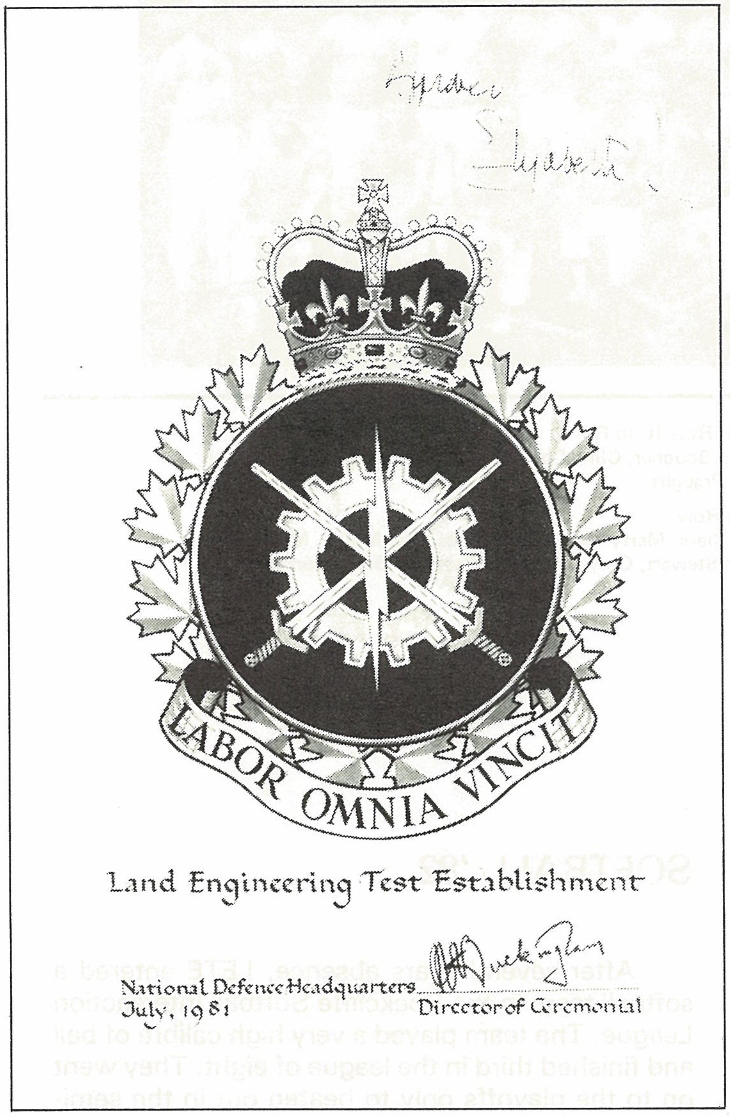
Back Row
George Vizeau, Ron Gabriel, Rick Lacelle, Marty Martin, Bill Ng, Jocelyn "Tebe" Charron, Rick Lefebvre, Chris Merritt, Tom Martin, Tim Murphy, Mike Veinot

SOFTBALL '82

After several years absence, LETE entered a softball team in the Rockcliffe Softball Intersection League. The team played a very high calibre of ball and finished third in the league of eight. They went on to the playoffs only to beaten out in the semi-finals. Plans are underway for the 1983 team to be even stronger. LETE personnel showed great interest, and fan support was by far the best in the league.

HOCKEY '82 - '83

For the first time, LETE entered a hockey team in the NDHQ Rec League at Rockcliffe for the 1982-1983 season. Although the team didn't win many games, they were competitive throughout. It was a good show for the beginning year and plans are to start early next season. With new personnel, greater participation is expected.



HISTORY OF LETE CREST

Over the years many attempts were made to introduce a unit crest for LETE. The objective was a design that would represent the Unit as a whole, and at the same time conform to the rules of heraldry. A crest that was designed in the mid-70s represented all aspects of the Unit's activities, but because it did not meet heraldric requirements could not be approved. A crest without the crown was used unofficially by LETE until a new design was approved in July 81.

The new crest was commissioned by the Commanding Officer, LCol (now Col) AL McEachern who, with the assistance of Mr. HW Banks and suggestions from both past and present members of LETE, submitted a design to NDHQ/Director of Ceremonial. The new crest accomplished the aim of representing the Unit as a whole by using broad emblematic descriptions; the gear wheel represents mechanical activities, the lightning flash represents electrical/electronic activities and the crossed swords indicates that the Unit, for the most part, supports the Army. The translation of the motto, "Labour Omnia Vincit" that was selected for LETE is, "Perseverance Overcomes All Difficulties".

The official unveiling of the crest took place 7 Apr 82. It was at this time that the Unit took the opportunity to present the first new crests to those members of LETE and NDHQ project officers who persevered and obtained approval for the new LETE development plan.

SAFETY AT LETE

Due to the nature of the facilities, equipment and work at LETE, the potential for injury, property damage, or both, is very high. Only through a consciousness of what could happen and a professional approach to the performance of every task, can accidents be prevented.

Safety is everyone's responsibility. The individual, the supervisor and management at LETE are made aware of their responsibilities by specific unit safety policies which are under constant revision by the Unit Safety Committee. The Commanding Officer is the Chairman of the Committee and he is assisted by the four Squadron Commanders, the Adjutant, the Engineering Operations Officer, the RSM, the Unit Safety Officer and the Unit Fire Prevention Officer.

The Unit Safety Officer is in turn Chairman of the Unit Safety Sub-Committee which is composed of the four Squadron representatives, the four specialist Safety Officers for Radiation, Laser, Chemical and Vehicle Safety and one civilian representative. The sub-committee coordinates and recommends accident prevention measures by:

- reviewing and drafting safety orders;
- administering a year round accident prevention program; and
- reviewing recommendations resulting from safety and hygiene inspections to ensure that appropriate action is taken.

1983 was marked by the creation of two awards: the Safety Merit Award and the Fire Prevention Award. These are given to the Squadron which best distinguished itself during the past quarter in the two areas.

VEHICLE PERFORMANCE TESTING

by Lt FA Robillard

LETE is frequently called upon to perform thorough performance tests on new or prototype vehicles which are under consideration for use in the Canadian Forces. Over the past few years the 1-1¼ Ton vehicle and the AVGP have been evaluated at LETE. More recent examples include the MLVW and the VW Iltis.

The VW Iltis is the latest vehicle to undergo a vehicle performance test program and it will be used as an example throughout this article to illustrate what a test program entails from the LETE standpoint.

The Iltis is a ¼ Ton vehicle which was selected as a contender in the Light Utility Vehicle (LUV) program, aimed at replacing the current fleet of ¼ Ton vehicles. The Iltis is a 4 x 4, 4 seat light utility vehicle which has a 1.7 litre SI engine that produces 55 kW (77 Bhp) at 5000 RPM. The vehicle is equipped with rack and pinion steering, drum brakes and a standard transmission. As with all new vehicles and prototype equipment, the Iltis was given a complete examination to confirm dimensions and physical characteristics and a full photographic identification series was taken. One of the Iltis' profile photographs from the identification series is presented below as Figure 1.

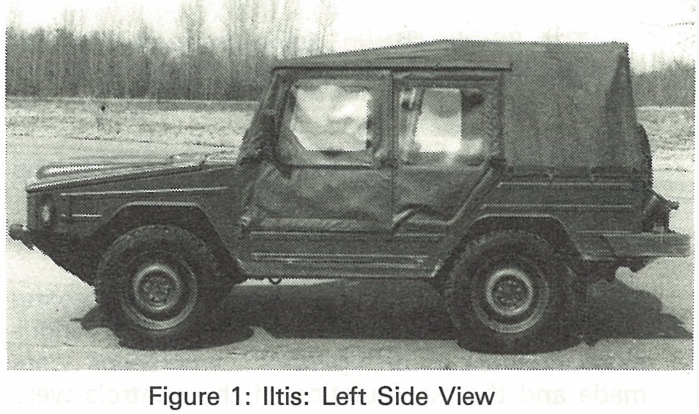


Figure 1: Iltis: Left Side View

This is usually one of the first steps of a complete performance evaluation which follows a carefully prepared "plan of test" developed by the test officer.

The task of measuring dimensions and taking photographs of a test vehicle involves perhaps an assistant and a photographer, however the more complicated engineering tests may involve the scheduling and coordination of several sections such as the test drivers, instrumentation, maintenance, fabrication and photographic sections.

The engineering tests carried out can vary depending on NDHQ requirements and the vehicle under test, but the following tests are normally done to establish performance limits and to confirm manufacturer's claims:

- Centre of Gravity
- Weight and Load Distribution
- Gradeability and Side Slope Performance
- Field of Vision
- Obstacle Crossing Performance
- Turning Diameter
- Fording
- Acceleration
- Braking
- Maximum and Minimum Speeds
- Endurance Tests (RAM-D)

The Iltis is shown going through different aspects of a slope test in Figures 2 and 3.

Figure 4 shows the Itlis being suspended for the Center of Gravity Test.

In the case of the Iltis, a human engineering evaluation was also carried out during which various measurements of an operator's workspace were made and the manipulation of the controls were

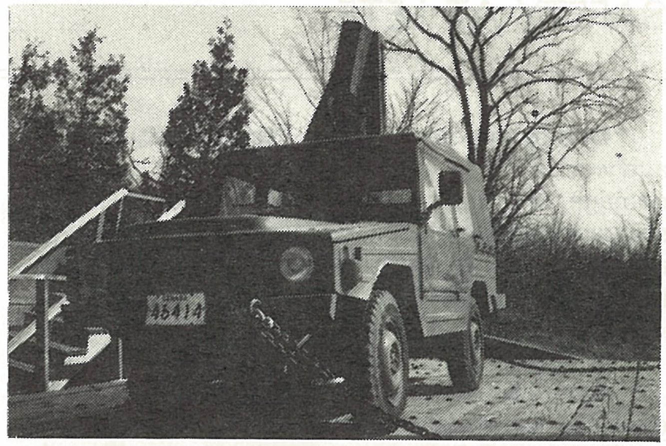


Figure 2: Unladen Iltis During Static Side Slope Test

Figure 3: Iltis Backing Up 60% Slope

Figure 4: Iltis During Center of Gravity Test

attempted. Some activities related to human engineering evaluation are releasing the hood latch while wearing arctic mitts or measuring the width of the driver seat to ensure it complies with specifications.

Another aspect of testing done at LETE for new vehicles is the endurance test. The vehicle is subjected to various types of terrain such as soft soil, cross-country, secondary road and paved surface. Figure 5 shows the Iltis fording during the endurance test.

Figure 5: The Iltis During Endurance Test

During the many miles of an endurance test, breakdowns and component failures are recorded and tabulated. This type of testing often helps to work out kinks in the overall design, and some examples of areas which were determined to be in need of modification were as follows:

- The headlights and windshields cracked too easily when hit by flying gravel kicked up by other vehicles.
- The four wheel drive/differential lock-up lever guide knob sheared off on all vehicles after only a few applications; and
- The wheel rims easily became dented, thus causing flat tires. The body metal also dented easily.

In general though, the Iltis came through the test program with flying colours, receiving many positive comments from the drivers who spent up to seven hours a day behind the wheel.

This is by no means the end of LETE's role in learning more about the Iltis and further evaluating its overall performance and confirming the satisfactory and reliable operation of the various systems. Upcoming are Electromagnetic Compatibility Testing, evaluation of manufacturer and DND proposed modifications, and finally RAM-D testing on production vehicles if the programme receives the final go ahead.

In this article, most of the more common engineering tests have been mentioned but there are many other tests which are within LETE's capabilities. For example, measurement of internal and external noise levels to aid in the evaluation of human engineering and security from detection; engine and power train cooling tests; draw bar pull tests, and shock and actuator tests to mention only a few.

There is no doubt that these engineering tests carried out by LETE on prototype or new vehicles, play a significant and necessary role in the selection of vehicles for the CF by providing the in-house unbiased quantitative and qualitative assessment required.

— * —

LETE'S TRACK TESTING EXPERIENCE

by MD Cummings and Maj JC Guerette

INTRODUCTION

Not too long ago our field troops in Europe and Canada were subjected to a road speed restriction of 10 km/h on the M113 APC because of its unpredictable and unreliable DIEHL 213B track system. The unsuitability of this track was clearly demonstrated in 1977 in Europe during EX REFORGER where the Brigade experienced 77 random catastrophic track pin failures, luckily with no one getting seriously injured. This situation was unacceptable and in addition to hurting the pride of the CAF personnel and its commanders, it seriously limited the operational capability of our Forces and our ability to meet our NATO commitment. Therefore, a durable solution to this APC track problem had to be implemented as quickly as possible.

In 1977 following this rash of track pin failures, DCMEM, the M113 vehicle Life Cycle Materiel Manager (LCMM), Diehl KG, the track manufacturer, and QETE, the DND metallurgy experts, set out to investigate and solve the problem.

DURABILITY TESTING RATIONALE

This was not an easy task since no one in Canada had much experience in the design and manufacture of the AFV tracks. The major difficulty in assessing the reliability of track system is to obtain the loading profile. Contrary to the static loads which can be determined relatively easily, the dynamic loads are more difficult to determine because of the following factors:

- Changing terrain profiles and conditions
- Vehicle load and suspension characteristics
- Vehicle Speed
- Driver habits

Many experts have attempted to measure the loading profile and cycle that a track shoe assembly is subjected to during operation, but have not achieved the precision required for track shoe design.

In the development of solutions to the Diehl 213B track problem, it was evident from the above that computer modelling and laboratory tests would serve little purpose and that confidence in any proposed solution could only be achieved by actual vehicle testing. That is why in this particular case, LETE was so instrumental in achieving a solution to this track problem.

TEST STANDARDS

After some investigative efforts by QETE and the track manufacturer, and a limited field trial in Europe in early spring 1978, LETE was tasked to conduct a durability test on some improved 213B track shoes. To meet this test requirement, standards and methods had to be established. It was imperative that the LETE test result could be correlated with field results. The first and most important requirement was to select a suitable test course within the LETE Orleans test area.

The test course was chosen to subject the track to almost any condition it may encounter in normal field use. The selected course is 16.40 km long and consists of 43% paved roads, 12% granite blocks (Figure 1), and Belgian Pavé (Figure 2), 8% rough cross-country (rock out-croppings) (Figure 3), 16% cross-country, 11% unpaved roads (gravel) and 10% sand.

Figure 1: Granite Block Course

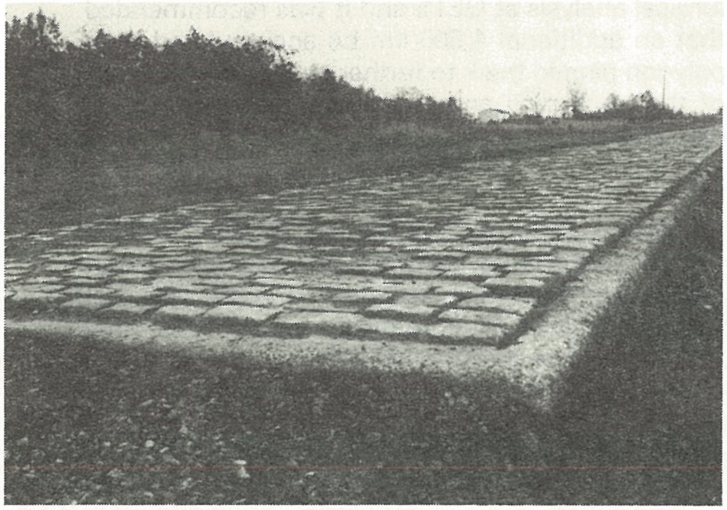


Figure 2: Belgian Pavé

Figure 3: Rock Out-Croppings

In order to establish a standard and ensure safety, a maximum speed specification was set on the different portions of the test course as follows:

- Paved road - 48 km/h
- Granite blocks and Belgian Pavé - 16 km/h
- Rough cross-country - 8 km/h
- Gravel roads, sand and cross country - 32 km/h

The paved road traversed at relatively high speed will have a tendency to build up heat in the rubber components, thereby degrading the rubber properties and inducing high frequency load cycles in the metal components which accelerate crack propagation to fatigue failure. The Granite blocks, the Belgian Pavé and the rough cross-country (rock out-cropping) cause impact loads on the track which remove chunks from the rubber pads and initiate cracks in the metal components.

The field and sand portions of the test course introduces grit between the sprockets and shoe bodies/end connectors which accelerates their wear.

In addition to the selection of specific test courses and strict vehicle speed control, the other factors which affect the track durability and performance had to be established and controlled. These are:

- The Vehicles. The M113A1 test vehicles were to be in excellent condition and be maintained in such a way that the vehicle could not affect the uniformity of test results. Vehicle availability had to remain high to ensure the timely completion of the high mileage durability test. To achieve this, the close support of LETE No. 1 Workshop was necessary.

- The Drivers. To prevent driver influence on the test results, the drivers were rotated from one test vehicle to another on a daily basis. Ideally, the test drivers' skill and experience was to be the same as found in combat arms units.

Additionally, in order to obtain reliable test data, regular examination of the track during the test was required. It was agreed that a non-destructive testing (NDT) of the track metal components would be completed every 1000 km to determine the level of deterioration, and the safety of pursuing the test with a weakened track. QETE 9 provided the NDT support.

TRACK TESTS

Once all the above had been established and agreed to by all, the 1978 LETE track test was started. This task consisted of accumulating 8000 km on four types of treated track pins.

Each type had been case hardened by a different process in an attempt to find a more durable pin. This test involved one APC, with tracks made up of segments of track with each type of pin, being driven two shifts per day for several months. A total of 7366 km were accumulated in two months before testing was halted because several catastrophic failures of track pins had taken place.

In 1979 LETE was requested to test 18 different configurations of Diehl track pins, each with either a different shape, material and/or hardening process. Due to the severe deadline imposed, this test necessitated the use of six carriers operating for two seven hour shifts per day. LETE's establishment of 10 drivers could not begin to cope with the requirement and still support the 50 to 60 other active tasks within M Sqn. Therefore, 24 drivers and mechanics were brought in from FMC units to assist in the test. This test required and received a monumental effort from all involved and the 10 000 km on each track configuration was completed in 62 working days.

The test was totally successful in that it led the way to the final solution to track pin failure by identifying what is now known as the polygon pin currently used in the DIEHL 213G track. The field test results obtained at LETE were confirmed by metallurgical analysis at QETE and it was recommended that an additional 4 800 km be accumulated on a polygon pinned track to further study the behaviour of the track pins and to attempt to establish life expectancy.

Based on the result of this test, DCMEM decided to confirm the reliability of the polygon pin through a field user trial which started in Jan 80. This trial was conclusive and led to the adoption of the Diehl 213G for use on the CAF M113 APC. The complete 4 CMBG fleet of M113 FOV and LYNX vehicles were retrofitted with this improved track in time to participate in the EX REFORGER 1981.

In an effort to keep abreast with AFV track technology, DCMEM has since tasked LETE almost every year to test different track systems. In 1980, LETE confirmed the improved reliability of the reinforced end connector (Figures 4 and 5) of the DIEHL 213G track system through a 10 000 km durability test, and the same year completed a similar test on the M70 Swedish track (Figure 6). In 1982 LETE initiated the durability testing of the XT 153 track (Figure 7) provided by FMC Corporation and the US Army XT 150 prototype track (Figure 8). This test is still continuing.

CONCLUSION

This track testing program is just another demonstration of LETE's essential contribution to the solution of the CAF technical problems thus ensuring its capability to meet its role.

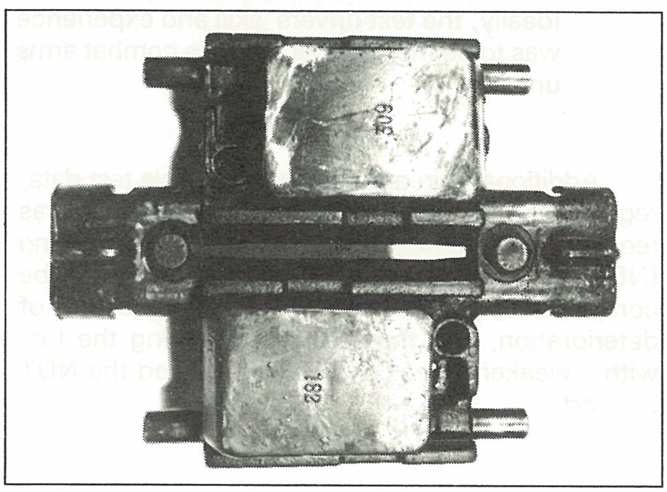


Figure 4: Diehl 213G Track with Standard End Connectors

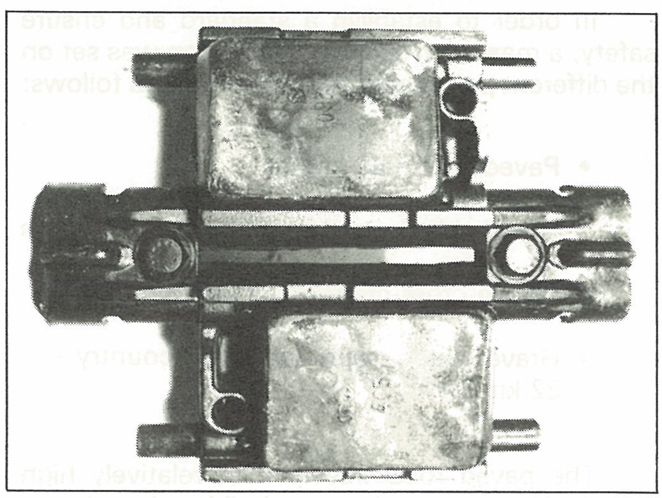


Figure 5: Diehl 213G Track with Reinforced End Connectors

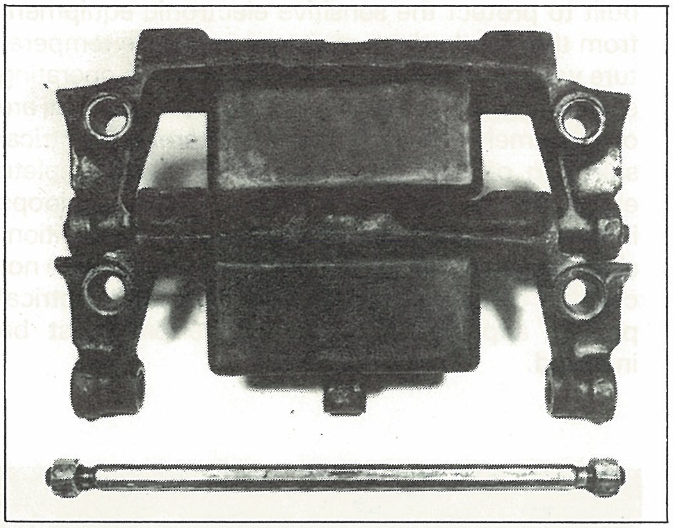


Figure 6: Swedish M70 Track

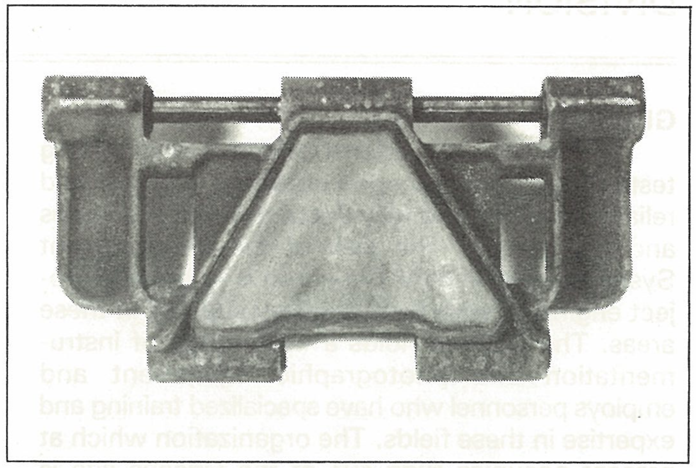


Figure 7: XT153 Track Provided by FMC Corporation

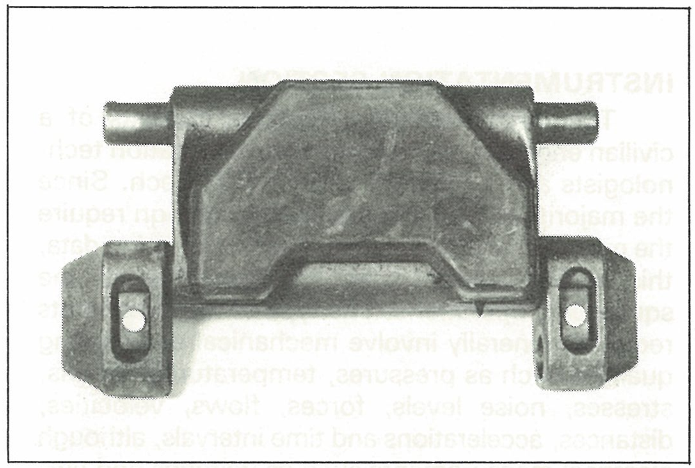


Figure 8: US Army XT150 Prototype Track

MEASUREMENT SYSTEMS DIVISION

by D Christenson

GENERAL

The ability to perform effective engineering tests depends heavily upon obtaining accurate and reliable test data and fully documenting procedures and test results. The task of the Measurement Systems Division of M Squadron is to provide project engineers with the necessary support in these areas. The Division holds a wide range of instrumentation and photographic equipment and employs personnel who have specialized training and expertise in these fields. The organization which at present occupies Bldg 401 at the Orleans site is supervised by a civilian engineer and is comprised of two sections.

INSTRUMENTATION SECTION

The Instrumentation Sections consists of a civilian engineer, two civilian instrumentation technologists and a Warrant Officer FCS Tech. Since the majority of projects assigned to M Sqn require the measurement and collection of engineering data, this section performs an important role in the squadron's operations. The type of measurements required generally involve mechanical engineering qualities such as pressures, temperatures, strains, stresses, noise levels, forces, flows, velocities, distances, accelerations and time intervals, although electrical measurements such as voltages and currents are often required on electrical systems.

Figure 1: Analysis of Vibration Test Data

The installation of complex measuring systems on a combat vehicle presents formidable challenges. Specialized mounts often have to be designed and built to protect the sensitive electronic equipment from the shock, dust, moisture and large temperature variations experienced in the vehicles operating environment. The majority of transducer outputs are of extremely low voltages and careful electrical shielding of transducer cables and the complete elimination of all possible sources of ground loops in the measurement circuit are essential. In addition, since many recording and amplifying devices are not capable of operating from the vehicles' electrical power, appropriate power converters must be installed.

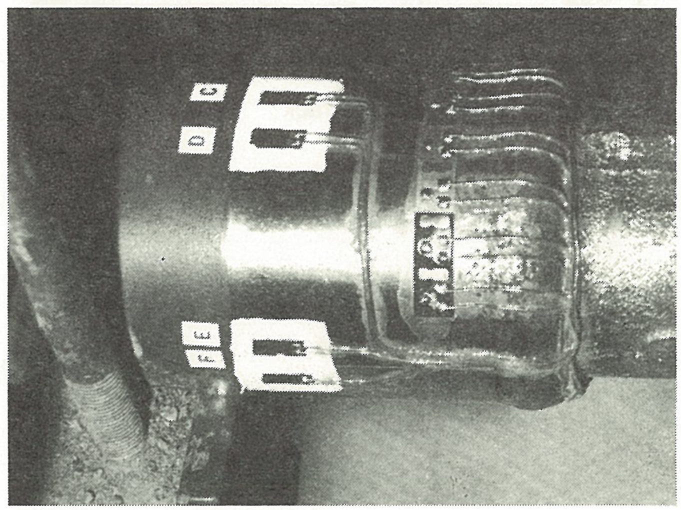


Figure 2: Strain Gauge Installation on ¾ Ton Trailer Axle

The section is often required to design and build specialized transducers to perform measurements. A common problem, for instance, is the requirement to measure forces where the introduction of a transducer would significantly change the operation of the mechanical system. In such cases, strain gauges are installed on the affected member and geometrically oriented and connnected so as to respond only to the desired load axis. It is thus possible to use the actual part as a transducer which responds only to compression and tension forces as an example, while cancelling out the effects of all bending and torque loads.

In data analysis, the section relies heavily upon its desktop computer. This machine is equipped with a number of interfaces which enables it to be directly linked to specialized equipment such as the digital signal analyser used in stress, noise and vibration analysis, scanner, voltmeters, data loggers and power supplies. With these systems, a static test can often be completely automated from the initial data collection, through the analysis to the final graphic presentation of the test results on a digital plotter for direct inclusion in the test report.

Over the years the Instrumentation Section has been involved in a wide range of projects. In addition to the large capital acquisition programs such as the 1 ¼ and 2 ½ Ton the section has been involved in assessing the state-of-the-art in electric vehicle technology, investigating the performance of the M113A2 suspension system, measuring stresses in vehicle track pins, determining the fuel economy of military vehicles, measuring loads on the axle housing of wheeled vehicles and trailers and evaluating vehicle cold-starting aids.

Because of the highly specialized nature of the test equipment held by the section, it is sometimes tasked with providing instrumentation assistance to Canadian industry in support of defence sales. Assistance was provided to GM Canada in support of their bid on the contract for the US Army LAV Project. Other vehicles such as road graders and a specialized Direction Finding (DF) vehicle have been instrumented by the section in support of foreign sales.

The LETE Development Plan will provide greatly improved accommodation for the section and will include a number of badly needed static test facilities such as engine and transmission dynamometers and a generator test cell. Future plans call for the increased use of computer controlled instrumentation systems and further enhancements of data analysis facilities. A PCM Telemetry System is expected in the near future which will allow test data to be remotely collected at a static receiving facility thus greatly alleviating the current problem of recording such data in severe environments.

PHOTOGRAPHIC SECTION

The Photographic Section is supervised by a Master Warrant Officer who has a staff of one Sergeant and two Corporals all of whom are Photo Techs with specialized training and experience related to engineering testing. The section is equipped with both HYCAM and LOCAM cameras for high speed filming of short duration events, 16 mm motion picture cameras, colour video equipment, a range of still cameras and copying equipment, dark room facilities and an ITEK 430 Processor which is used for photographic presentations in test reports and for producing overhead projections.

Since the majority of projects conducted by LETE requires photography, this section supports a wide range and large number of projects. On average, the section produces approximately 3000 B&W, 1500 colour prints and 1000 colour slides per year. All photographs which are selected for project reports are assigned unique numbers and the negatives are held for a minimum of ten years. In addition, all slides are reviewed and those that have either general or engineering historical value are cross referenced by year and subject matter and stored. An historical film library of tests conducted at LETE over the years is also maintained. For the last two years such filming has been almost exclusively performed on video tape and eventually all such films will be available in video.

The use of photography has proven to be indispensable for engineering tests at LETE since often the required information cannot be obtained in any other way. A prime example is in evaluating the effectiveness of camouflage where LETE has often been tasked to determine the effects of special disruptive pattern clothing or netting against various backgrounds of vegetation and terrain elements. A great deal of work has also been performed in support of small arms testing where high speed photography is used to examine the dynamic effects of firing a live round into a blank firing attachment or into another jammed round, to study cartridge ejection problems and to analyse weapon recoil.

In vehicle tests, photography is used to measure turning patterns of amphibious vehicles, to assess the effectiveness of a wire cutter installed in an Alpine snowmobile, to record the dynamic action of vehicle tie downs used in rail transportation, and to measure the area of vulnerability to enemy fire of a vehicle operator from different angles and distances. Photography can sometimes also be used to provide validation checks on data acquired through other systems. In one case where the

requirement was to record vehicle wheel displacements, a special course was set up so that the wheel motion could be recorded on video tape to verify that the output of the locally designed electronic measuring system was accurate.

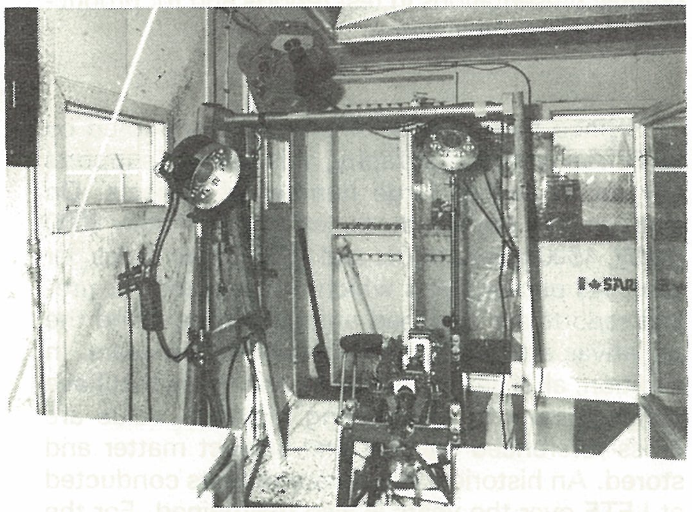


Figure 3: High Speed Filming for SARP Project

In addition to support of LETE tests, the section is often called upon to assist other organizations. Assistance has been provided to DGAEM at the NRC wind tunnel in support of the Aurora Program, and to DCIEM in support of human engineering studies on the AVGP.

One of the most common requirements of photography is in identifying system components. Special layouts are often performed in the studio to provide photographs for publication in CFTOs or operator manuals or to provide a guide to graphic artists in making detailed illustrations. Photography is used to a great extent in LETE test reports to provide clarity and simplify the explanation of complex procedures. LETE project engineers also have a range of visual aids such as 35 mm slides, OHPs and videotapes from which to choose when they are required to provide technical briefings or interim reports.

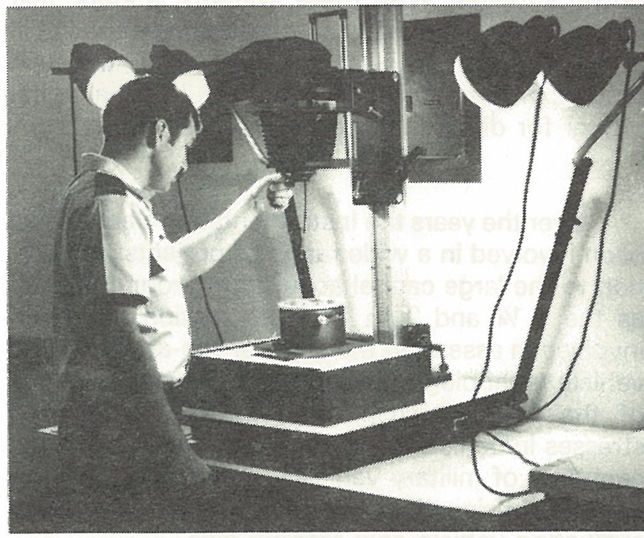


Figure 4: Test Item being Prepared for Identification

With the LETE Development Plan, the Photo Section, although remaining in Bldg 401, will be able to gain additional space. At present, the section is attempting to upgrade its capabilities in the area of video to include better editing and production facilities. One area which is being closely monitored is the state-of-the-art in high speed videography. It is hoped that in the near future 16 mm film can be completely replaced by video thus allowing immediate playback and analysis of test results. In addition, since video information can be interfaced with computer equipment, automated analysis techniques to replace the manual procedures now necessary, should be possible.

CONCLUSION

The personnel within the Measurement Systems Division take great pride in the role they perform within LETE. New problems are constantly presented that must be met with imagination and considerable innovation. The LETE Development, along with the rapid advancement in the technology encompassing both the instrumentation and photographic fields ensures that the future will continue to offer new challenges and that LETE will be in a position to meet these challenges, effectively, efficiently and professionally.

TESTING COMMERCIAL VEHICLES FOR SPECIFICATION COMPLIANCE

by RC Mabee

Over the past two years, LETE has continued to play a significant role in supporting DGLEM by testing to specifications new major pieces of commercial equipment. One of the more recent examples of LETE's contribution is the test program carried out on a Rapid Intervention Vehicle (RIV).

The Rapid Intervention Vehicle was built to satisfy the demand for stricter response times for airfield fire fighting equipment. As a result of contractual obligations, LETE was required to test in seven days from delivery, as much of the vehicle's performance capability as possible, and to identify any shortcomings. In this short span of time, LETE measured and confirmed all of the vehicle's dimensions and physical characteristics and conducted tests on lateral and longitudinal slopes, braking, acceleration, steering performance, internal and external sound levels, subjective ride quality, and limited endurance on hard surface and cross-country terrain.

Figure 1: RIV, As Received, Right Front View

These tests proved to be extremely valuable in that, while confirming that the vehicle met most of the specified performance capabilities, many minor faults were identified and a potentially serious brake problem accompanied by vehicle swerve became evident. The vehicle was unable to meet the SAE standard minimum stopping distance for vehicles in its weight class. The vehicle was tested using a fifth wheel and data recording instrumentation as shown in Figures 2 and 3.

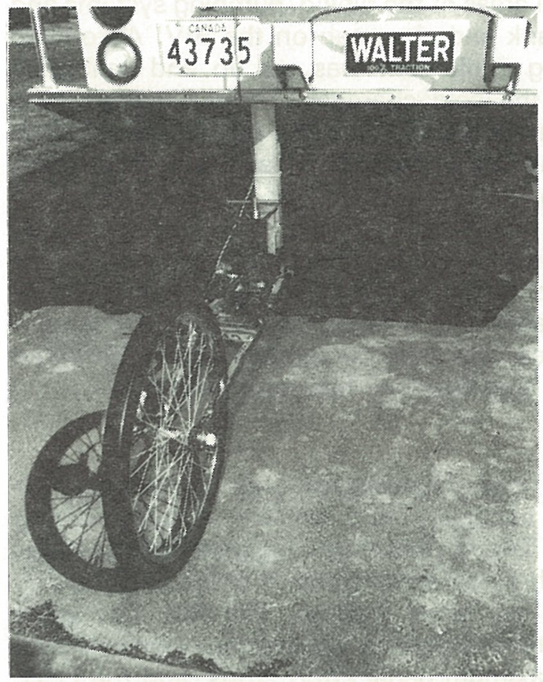


Figure 2: RIV With Fifth Wheel Installed

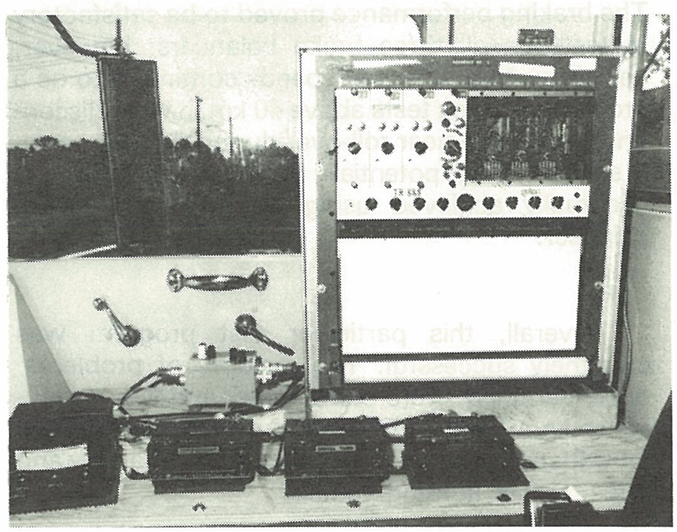


Figure 3: RIV With Instrumentation Installed in Cab

Following modifications and adjustments by the manufacturer to rectify the shortcomings, further testing was required. This time LETE was tasked to retest the braking performance and to evaluate the vehicle's cold weather performance. The conditions for the cold weather test were to simulate a situation with the RIV standing-by at the end of a runway for four hours under ambient temperatures of -40°C. LETE personnel secured the use of the NRC cold chamber to meet this requirement. LETE technicians and engineers placed 12 thermocouples in critical areas of the piping/pumping systems and in the tank and crew cab on the RIV. Automatic recording equipment was set up and calibrated outside the cold chamber. Three separate tests were conducted over a three month period, each test being unsuccessful because one or more pipes froze up. After each test, the manufacturer tried various modifications which included improved insulation of various pipes, redirecting heater air flow and finally, supplementing the original fuel fired heater with a liquid to air heat exchanger. A final test was then carried out which confirmed that the specifications had now been met.

The next requirement was to reassess the braking capability and vehicle stability during braking. The manufacturer suggested the installation of three different types of brake balancers to prevent rear wheel lock-up. The RIV was again instrumented to provide the brake performance data under maximum pedal effort stops, and the LETE Photo Section provided video coverage so that any vehicle swerve could be observed and fully analyzed. The braking performance proved to be satisfactory in tests on all three brake balancers; however, vehicle swerve at higher speeds continued to be a problem. Braking tests above 40 km/h were discontinued due to a near roll-over during the first tests. A solution to this potentially dangerous situation was eventually achieved using an adjustable brake balancer.

Overall, this particular test program was extremely successful. The majority of problems, once identified, were correctable, and it is gratifying to know that LETE contributed to the eventual introduction into the Canadian Forces of a new and effective fire fighting vehicle.

Other recent examples of LETE's endeavours in testing to specifications are the Remtec 4000 Gallon Aircraft Refueller and the Sellick Aircraft Towing Tractor.

The Canadian Forces is being equipped with 157 of the new refuellers to replace the aging fleet of 4x6 FWD vehicles manufactured by Fruehauf in 1965/66. The prototype highway model was sent to LETE for qualification tests in August 1982 following a six week user trial at CFB Ottawa(S). The aim of the test program was to identify possible defects on the prototype vehicle so that corrective action could be taken if necessary before production units were delivered to DND by the contractor.

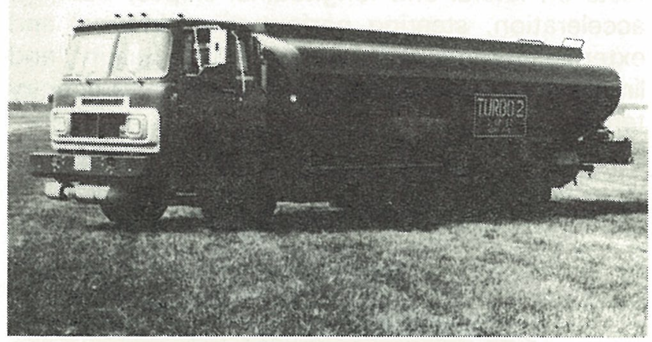


Figure 4: The Remtec 4000 Gallon Refueller As Received at LETE

The LETE evaluation included automotive tests such as steering, braking, acceleration and durability checks, with various fuel load configurations, pumping and metering tests, and checks of the automatic fire protection system. All tests were conducted with JP4 aircraft fuel on board in accordance with the practices outlined for fuel bowsers by the U.S. Armor and Engineer Board. Water and other fuels were not used as substitute loads due to their different specific gravity and viscosity, and the extreme contamination they would produce in the refueller plumbing and filters. The use of other liquids would have affected vehicle weight and road handling as well as pumping performance. The presence of up to 4000 gallons of JP4 fuel dictated that the test program would be conducted in a particular sequence with a variety of on-site and stand-by safety support from outside agencies, in order to minimize hazards to personnel and facilities.

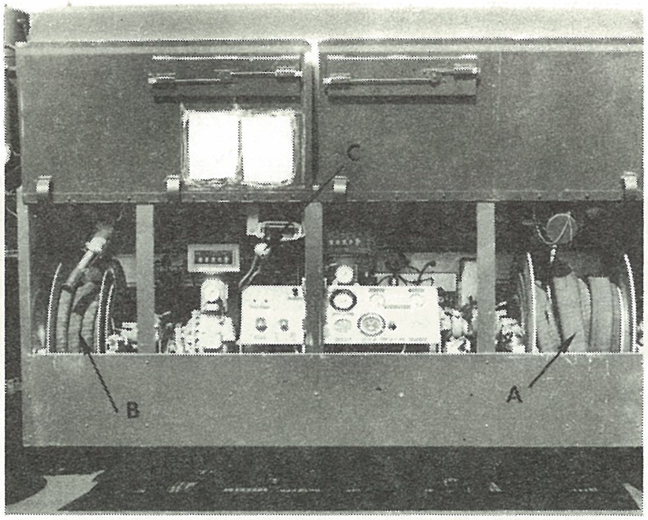


Figure 5: Left Side View of the 4000 Gallon Refueller Showing the Pump and Meter Compartment with Both Doors Open

A. Main Pressure Fill Hose and Nozzle in Stored Position

B. Overwing (Gravity Feed) Hose and Nozzle in Stored Position

C. Deadman Switch in Stowed Position

Figure 6: Rear View of the Refueller Undergoing Braking Trials with a Partial Load

The Remtec refueller met all automotive and fuel dispensing requirements. The gross vehicle weight ranged from 12 126 kg (25,745 lbs) empty to 25 701 kg (56,660 lbs) fully laden. The maximum fuel flow rate from the pressure fill dispensing system was 2 250 litres per mintue (495 gal/minute). The usable capacity of the 4000 gallon fuel tank is 17 830 litres (3,922 gallons) with a decreasing flow rate after defuelling the first 15 000 litres (3,299 gallons). "A full fuel tank can be emptied in 10.5 minutes."

The Ansul automatic fire suppression system consists of two sub-systems: a pneumatically operated fire detection and actuation circuit, and a fire suppression system with pre-set nozzles in the fire prone areas of the vehicle. The detection circuit consists of special plastic tubing which is routed through the vehicle chassis and charged with nitrogen at 552 kPa (80 psi). In the event of fire, the tubing is designed to melt at 179°C (355°F) and release the nitrogen. The pressure loss in the detection circuit then actuates the suppression system.

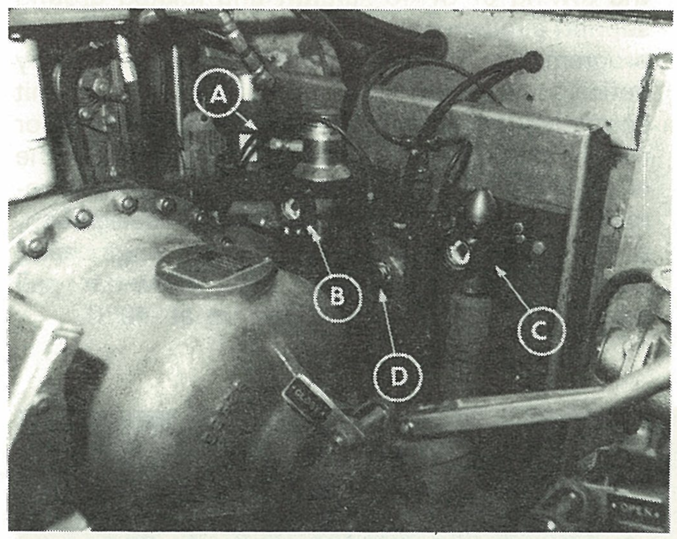


Figure 7: Detailed View of Ansul "Checkfire" Pneumatic Detection and Actuation System Components

A. Detection Tubing Filled with Nitrogen Gas at 552 kPa (80 psi)
B. The Detection and Actuation Device (DAD)
C. The Pressure Make-up Device (PMD) Containing Nitrogen Gas at 5210 kPa(900 psi)
D. Low Pressure Warning Light

The fire suppression system was actuated manually to produce a heavy concentration of extinguishing agent in the forward area of the fuel tank. Minor faults requiring repair were noted during the above test including a slow leak from the detection circuit pressure gauge. It was also discovered that the detection tubing was routed to areas on the vehicle where no suppression capability existed. The fire suppression system underwent further evaluation at the design level regarding the possible incorporation of an automatic fuel flow shut-off device.

No major mechanical failures were experienced during the 1395 km test program. A list of observations was forwarded from LETE to the NDHQ Project Officer in September 1982 in support of contract negotiations.

The Sellick Aircraft Towing Tractor was evaluated by LETE during the summer of 1983 in support of the Canadian Forces procurement of 84 tractors. These vehicles are intended primarily for the towing of CF-18 Aircraft and related ground support equipment. Once again the aim of the test program was to check specifications and identify deficiencies on the first vehicle in order to permit corrective action to be initiated, if required, prior to the production of the remaining units. The engineering evaluation included a variety of automotive tests such as steering, braking, acceleration, sound level measurement, human engineering checks, drive-line cooling tests, draw-bar pull tests, and a cold chamber start-up at -40°C.

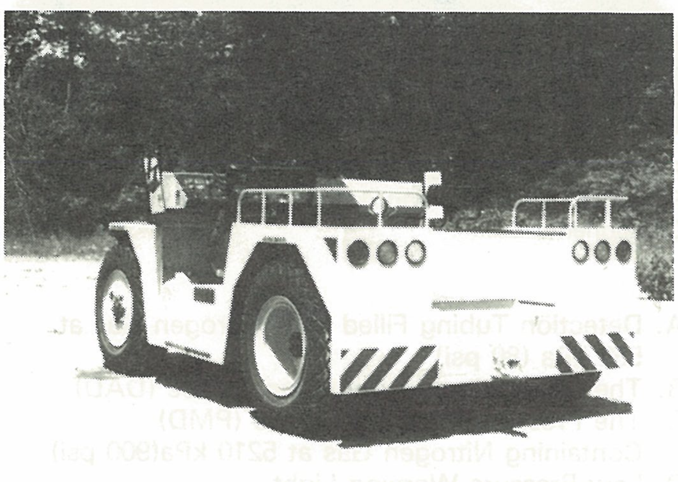


Figure 8: Left Rear View of the Sellick Aircraft Towing Tractor as Received at LETE

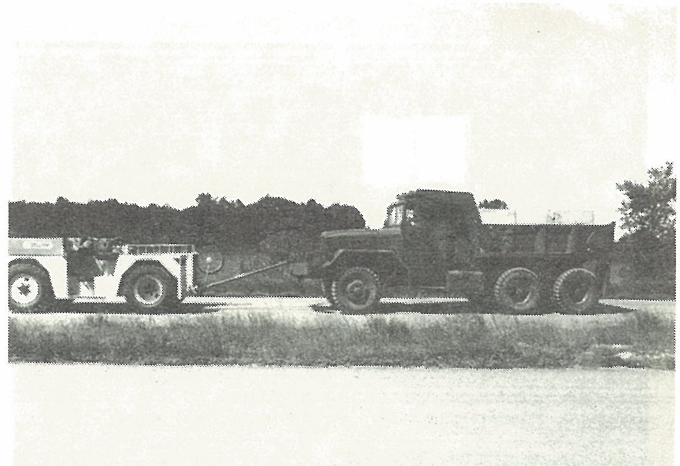


Figure 9: The Sellick Aircraft Towing Tractor with its 19 070 kg (42,000 lb) Simulated "Fighter Aircraft". The Illustrated Towing Hardware was used for Drive-Line Cooling Tests and Non-Slip Draw-Bar Pull Tests

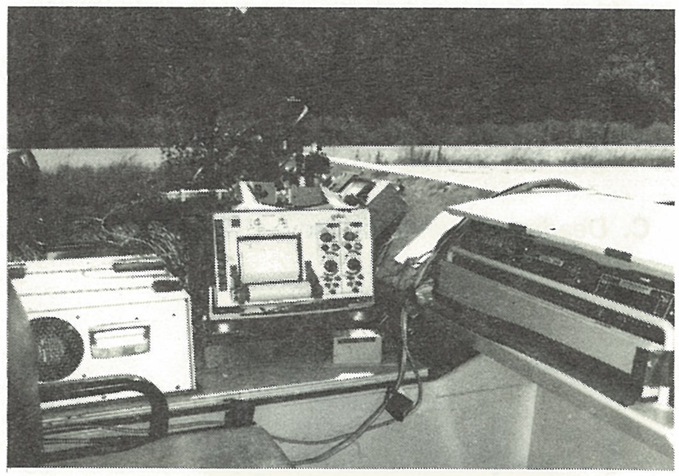


Figure 10: Close-Up Left Side View of the Sellick Towing Tractor Showing Time, Distance and Velocity Meters Mounted on the Dash. The Chart Recorder in the Centre of the Vehicle was Used Initially to Measure Pedal Force Application During Braking Tests. It was later Re-instrumented to Record Draw-Bar Pull Values.

The measurement of draw-bar pull performance and drive-line cooling capacity are considered to be the most important checks of the towing tractor's suitability for its intended role. Pull-down (moving) draw-bar tests were conducted on asphalt in each gear range at selected speeds under maximum throttle. The towed 5 ton SMP "dynamometer" vehicle was instrumented with a fifth wheel so that the second driver could accurately control the test

speeds by the progressive application of his brakes. Static draw-bar pull tests were conducted on asphalt and cement surfaces under maximum throttle in all gear ranges. Where wheel slippage was a factor in the lower gear ratios, the tow bar was replaced with a chain to provide a more horizontal pull than the hardware illustrated in order to eliminate the effects of uplift on the rear of the tractor. Draw-bar pull values ranged from a high of 4 360 kg (9,600 lbs) at 0 km/h in first gear, to 3 630 kg (800 lbs) at 25 km/h (15.5 mph) in fourth gear.

Drive-line cooling tests required the installation of six thermocouples in the following locations: engine coolant "IN", engine coolant "OUT", engine oil, transmission/transfer case oil, and front and rear differential housings. The towed 5 ton SMP dynamometer vehicle (GVW 19 070 kg or 42,000 lbs) were allowed to free-wheel where it extered a towing resistance of 1,400 to 2,000 lbs on the oval track.

After 1 ½ hours of continuous towing at maximum throttle in high gear, the tractor had travelled 35.7 km (22.3 miles). The test was terminated as the rear differential temperature had reached 101°C (214°F). The manufacturer of the axle subsequently advised that the axle could be operated at temperatures up to 122°C (250°F) with the existing lubricant. It was concluded that the tractor would not experience any heating problems on an airfield, however, abnormal highway trips with heavy loads might cause the rear differentials to fail from over-heating.

In other tests, the overall performance of the tractor was found to be satisfactory. One major incident occurred when an open wiring harness clip allowed the alternator output wire to rest on the exhaust pipe. The resulting electrical fire destroyed the main engine harness and a large portion of the wiring under the dash. The damage was repaired by the contractor's personnel with the assistance of the LETE workshop. Additional harness clips were installed on the vehicle. Other minor faults were recorded and the list forwarded to the NDHQ design authority.

Although the test programmes just described all relate to airfield support equipment, they are simply examples of one particular type of work carried out by LETE on many types of vehicles and serve to illustrate the essential role played by LETE in specification compliance testing.

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ADP IN LOGISTICS SQUADRON

by Lt AW McDonald LOG

INTRODUCTION

The Log Sp Sqn at LETE is comprised of 23 military and civilian personnel. The primary role is to provide material and equipment in support of NDHQ approved projects assigned to LETE. Approximately 45 000 line items are maintained on manual stock record cards held within the four LETE supply groups (Stolport, Orleans, M23, Constitution (formerly Bourque) Bldg.) Roughly 150 000 transactions are posted to the stock record cards annually.

The main disadvantage of this manual method of accounting is its inflexibility in terms of the filing and retrieval of information. As a managment system it does not have the ability to index and recall various forms of detailed information in a way desired by the user. A program is now underway to resolve this problem.

BACKGROUND

It is reasonable to assume that change is inevitable in any organization. Modern day technology and state-of-the-art equipments have become an inherent part of any enhancement program. In particular, automatic data processing (ADP) is now viewed by many as an essential administrative requirement in the workplace. To that end, Log Sp Sqn is about to receive a long-awaited and much-needed facelift.

The stores enhancement program is a two fold project. It will require the integration of two separate and distinct computer systems. Operating independently, this unique computer arrangement will provide LETE with complete visibility and control of project stores from initial acquisition to ultimate disposal.

INTERFACE WITH CFSS

The first phase of this project involves the Canadian Forces Supply System (CFSS). LETE has acquired new computer hardware and has established a second-line account structure. In brief, LETE is now identified as an independent supply section, allowing direct access to the CF national stocks.

The most significant advantage of the new CFSS accounts is in the overall customer response time. Under the second-line system, inquiries on demand status, item history, unit assets and stock number validations will produce an immediate response at source. Automatic hastening by the computer on delivery date violations will assist greatly in the follow-up of outstanding demands. In addition, computer generated reports on material status, reject transactions, loans, stock number conversions, dues-in, stockage levels and other related activity will provide valuable management information not previously available under the first-line account structure.

THE MICROCOMPUTER

To complement the CFSS, a microcomputer will be introduced at LETE. The primary purpose of this new system will be to control the material and equipments issued in support of NDHQ approved projects — in short, to pick up where the CFSS leaves off. Because of LETE's geographical layout, four terminal locations, linked by a dedicated telephone modem system, will be utilized. This arrangement will not, however, reduce the fundamental capabilities of the system itself. The microcomputer will incorporate the latest ADP innovations. Software such as "WORDSTAR" and "dBASEII" will permit merging of standard texts together with the data base generated reports, to form a report package for each project. Off-line storage will provide for back-up and archive purposes. Simultaneous indexing on up to seven fields will be possible. In addition, the system will be user friendly with respect to data definition and manipulating languages. Screen-to-screen and printer-to-printer features are expected to maximize the use of electronic mailing. In operation, the new automated system will satisfy many user equipments that were not previously addressed or available.

It will of course offer quick response to user inquiries on demand activity, stock availability and other inventory related data. With its ability to sort and index information in a logical sequence, the computer will also serve as a valuable management tool. It will permit the retrieval of project information such as test equipment holdings, cost data, stock reservations, vehicle status and purchasing information in any form desired by the user. For instance, recognizing DND's present concern in the area of R&D expenditures, emphasis can now be placed on securing an effective and simplistic cost control program with an aim to capture all project related costs, including those of the CFSS and procurement direct from the trade.

CONCLUSIONS

The stores enhancement program is expected to take at least five years to complete. A working group with representatives from the Directorate of Supply Management has been formed to review the requirements of the phased program and to make recommendations for its implementation. One of the primary goals will be to achieve a degree of supply autonomy to fulfil LETE's commitment with respect to CFSS self-sufficiency. The rapid growth of technology and the need for automation will persist long into the future; however, LETE's present thrust will serve as a positive example for today.

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VISITORS TO LETE

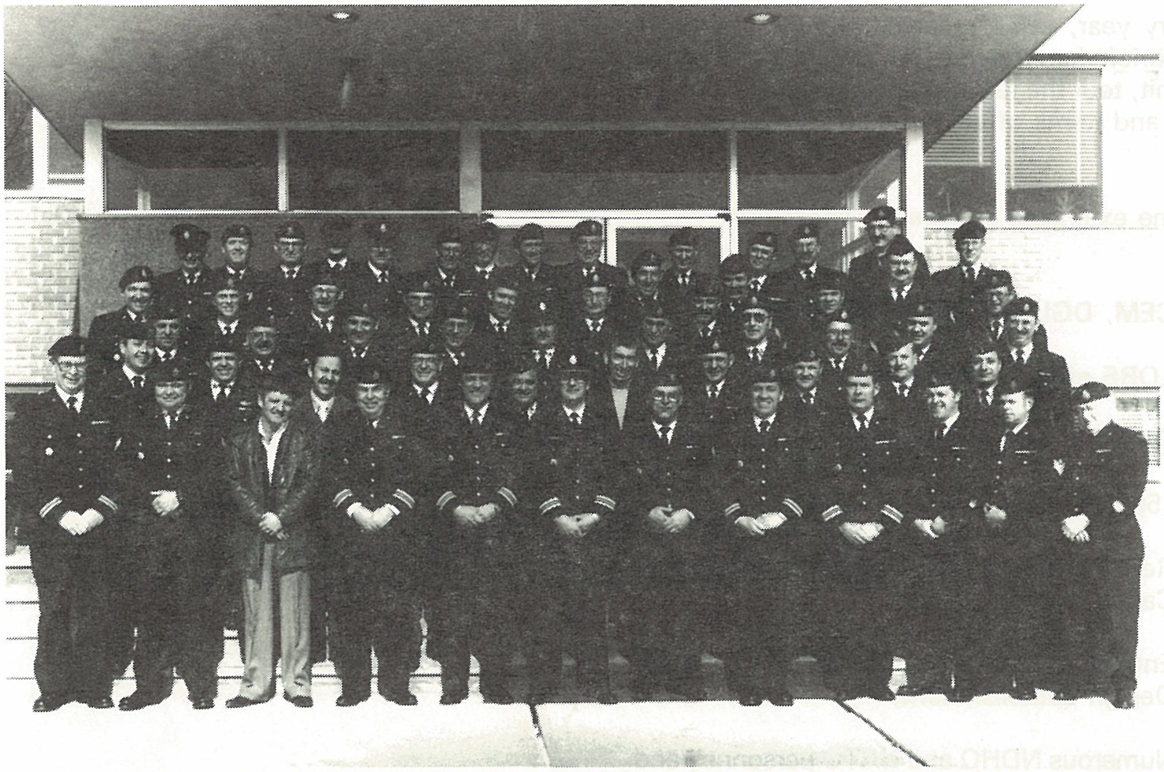
Every year, LETE receives numerous visitors who are briefed on the role, organization and scope of the Unit, tour the facilities, and discuss particular projects and items of equipment.

Some examples of recent visitors are:

- CEM, DGLEM, and DLES personnel;
- LORE officers Phase IV Courses;
- TQ6B W TECH L courses;
- 150 Cadets of the Ottawa Garrison;
- Representatives of Computing Devices of Canada;
- Engineers from the Australian Engineering Design Establishment;
- Numerous NDHQ and NATO personnel; and
- Officers and NCOs of various units.

On 29 Apr 82, LETE was honoured by the presence of General RM Withers, then CDS, who spent the day viewing operations of the Unit and meeting personnel.

29 Apr 82. General RM Withers accompanied by BGen RB Screaton and LCol DB Perrin, being briefed on electro-optics at LETE.



Air Command Land Technical Review Meeting 6-8 Mar 84

Bottom Row Left to Right
Capt McLean Sgt Pitt MCpl Curley Maj Fuller Maj Watts Maj Deschenes Sgt Flynn Capt Thurrott Maj Danahy WO Abtosway Sgt Gray MWO Moher

Second Row Left to Right
MWO Cathcart Sgt Morash Sgt Proteau CWO Pettigrew Sgt Galusha MCpl Holt Capt Shortell MWO Brown MWO Walton MWO Lussier

Third Row Left to Right
MWO McMillan WO Smulski WO Sears MWO Shehyn Sgt Filiatrault Capt Filipps CWO Radies Sgt Mumford MWO Cote Capt Lawrence

Fourth Row Left to Right
Maj Eif Capt Emmerson Sgt Gilchrist WO Bilodeau MWO Young Sgt Simard Sgt Laurent Sgt Beaudoin Sgt Desrochers Sgt White Sgt Durkee

Fifth Row Left to Right
Sgt Stephen MWO Swerdferger Sgt Landry MWO Sercerchi Sgt Johnston MWO Doiron Sgt Norman WO Harrison CWO Morgan CWO Toogood CWO Sloan Capt Desjardins Maj Kirkland Capt Irwin